000
MCBSF
6.5
2/1/01

SEDIMENT CAP BASIS OF DESIGN
MCCORMICK AND BAXTER CREOSOTING COMPANY SITE
PORTLAND, OREGON

February 2001 *Task Order No.: 88-97-19*

Prepared for:

Oregon Department of Environmental Quality
811 Southwest Sixth Avenue
Portland, Oregon 97204

ecology and environment, inc.

SEDIMENT CAP BASIS OF DESIGN
MCCORMICK & BAXTER
CREOSOTING COMPANY
PORTLAND, OREGON

Task Order No. 88-97-19

February 2001

Prepared for:

OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY
811 Southwest Sixth Avenue
Portland, Oregon 97204

Table of Contents

Table of Contents (Cont.)

Section | Page

Table of Contents (Cont.)

Note: This page is
intentionally left blank.

List of Tables

Note: This page is
intentionally left blank.

List of Illustrations

1 Introduction and Purpose

E & E
Ecology and Environment, Inc.

DEQ
Oregon Department of Environmental Quality

RD
remedial design

McCormick & Baxter
McCormick & Baxter Creosoting Company, Portland Plant

Ecology and Environment, Inc. (E & E), under contract to the **Oregon Department of Environmental Quality** (DEQ; Task Order No. 88-97-19), has prepared this basis of design document in support of the **remedial design** (RD) for contaminated sediment at the **McCormick & Baxter Creosoting Company, Portland Plant**, (McCormick & Baxter) site in Portland, Oregon. This document describes the proposed RD for the capping of the contaminated sediment. Data collection to support the RD is nearly complete. Field verification of river current modeling cannot be performed until the appropriate conditions prevail, including an elevated water surface level on the Willamette River and a significant storm event. Therefore, this report presents the preliminary design of the sediment cap. Additional results of data analyses will be incorporated into contract documents, the creation of which is the next step in the RD.

RA
remedial action

ROD
Record of Decision

PAHs
polycyclic aromatic hydrocarbons

PCP
pentachlorophenol

The site, a former wood-treating facility, is located along the Willamette River at 6900 North Edgewater Street (see Drawing 1). The purpose of the task order is to conduct RD and **remedial action** (RA) activities at the site in accordance with the remedy described in the **Record of Decision** (ROD) dated March 1996 and amended in March 1998. The ROD identifies remedies for soil, sediment, and groundwater contaminated mainly with **polycyclic aromatic hydrocarbons** (PAHs), **pentachlorophenol** (PCP), arsenic, and dioxins/furans. The contamination resulted from wood-treating operations conducted on the McCormick & Baxter property from 1944 to 1991. The selected sediment remedy for the site involves capping Willamette River sediment contaminated above cleanup goals.

Following this introductory section, the basis of design presents a site description and history (Section 2), a discussion of the nature and extent of contamination (Section 3), RD objectives (Section 4), design components (Section 5), a discussion of RD deliverables

(Section 6), permitting requirements (Section 7), contracting strategy (Section 8), a construction schedule and cost estimate (Section 9), and references used to prepare the document (Section 10).

2 Site Description and History

RI
remedial investigation

RIR
remedial investigation report

PTI
PTI Environmental Services

FS
feasibility study

The McCormick & Baxter site covers approximately 60 acres in and adjacent to the Willamette River in Portland. A description and history of the site, mainly excerpted from the **remedial investigation** (RI) **report** (RIR; **PTI Environmental Services** [PTI] 1992a), revised **feasibility study** (FS; PTI 1995), and ROD (EPA 1996), are provided below.

2.1 Site Description

The McCormick & Baxter site (see Drawing 1) is located on the Willamette River in Portland, downstream of Swan Island and upstream of the St. Johns Bridge. The Willamette River flows to the northwest adjacent to the site. The site is located in an area that was constructed by placement of dredged material sometime in the early 1900s. The site, which encompasses approximately 43 acres on land and 17 acres in the river, is generally flat and lies between a 120-foot-high bluff along the northeast border and a 20-foot-high bank along the Willamette River to the southwest. A sandy beach is exposed at the base of the bank, except during brief periods of high river stage (generally late winter or early spring). The site is bordered by inactive industrial properties along the river and by a residential area on the bluff.

In the early 1900s, the first industrial structure, a sawmill, was built at the site. In 1944, the McCormick & Baxter Creosoting Company began wood-treating operations that continued until October 10, 1991. Four retorts at the site were used for various wood-treatment processes:

- Retort 1: Creosote in aromatic oils (1945 to 1991);
- Retorts 2 and 4: PCP in aromatic oils (1953 to 1991);
- Retort 3: Water-based treatment (chromium from 1954 to 1970, ammoniacal copper arsenate from 1970 to 1986, and ammoniacal copper zinc arsenate from 1986 to 1991); and

- Retort 4: Cellon (PCP in liquid butane and isopropyl ether; 1968 to 1988).

A 750,000-gallon creosote tank within a dike and a diked tank farm with several additional tanks for storing wood-treatment chemicals were present at the site. Chemicals for water-based treatment also were stored in tanks near Retort 3. Chemicals that remained following shutdown of the site were inventoried and removed by DEQ in 1992 in an interim site stabilization action. All chemical storage tanks and retorts were cleaned, dismantled, and removed by DEQ in 1994.

CPA
central process area

FWDA
former waste disposal area

From 1950 to 1965, waste oil containing creosote and/or PCP was applied to site soil for dust suppression in the **central process area** (CPA). Liquid process wastes reportedly were discharged to a low area near the tank farm before 1971 (E & E 1983). Contaminated soil was removed from this area in the mid-1980s. From 1968 to 1971, process wastes were disposed of in the **former waste disposal area** (FWDA) in the southwest portion of the site.

The site had a wastewater discharge outfall (Outfall 001) that was used to discharge cooling water when the plant was operating. Contact wastewater also was discharged from this outfall in the early years of operation. Three stormwater outfalls (Outfalls 002, 003, and 004) also were present along the river. Outfalls 001 and 002 were permitted under the National Pollutant Discharge Elimination System. Following plant shutdown, DEQ placed earthen berms around stormwater collection sumps at the site as an early response action to minimize off-site discharge. All four of these outfalls were removed as part of soil RA in early 1999. Currently, stormwater at the site infiltrates into the subsurface.

IRAMs
interim removal action measures

TFA
tank farm area

GTS
groundwater treatment system

Several **interim removal action measures** (IRAMs) have been conducted by DEQ contractors at the McCormick & Baxter site. Two new office trailers, a former shop building (currently used to house the **tank farm area** [TFA] groundwater treatment plant), and an intermodal container (housing the FWDA **groundwater treatment system** [GTS]) remain at the site. All other structures were removed as part of recent demolition and removal activities.

MSL
mean sea level

BNRR
Burlington Northern Railroad

2.1.1 Topography

The McCormick & Baxter property is located on a terrace that is generally flat, with surface elevations ranging from approximately 29 feet to 36 feet **mean sea level** (MSL). The site is part of a larger industrial area that includes a former cooperage and shipyard to the northwest (Willamette Cove property) and the former Riedel International property to the southeast. The **Burlington Northern Railroad** (BNRR) tracks that border the site on the northwest are located on an embankment that is elevated approximately 40 feet above the site. The northeast side of the site is bordered by Union Pacific Railroad tracks and a naturally formed, 120-foot-high bluff. Atop this bluff is a residential area. A narrow, vegetated, 20-foot bank separates the site from the Willamette River on the southwest. A sandy beach is exposed at the base of the bank, except during periods in late winter or early spring when higher river stages (greater than 15 feet) prevail. Surveyed beach elevations generally range from 10 feet to 15 feet MSL.

Elevations on the site generally are highest at the base of the 120-foot-high bluff, ranging from 30 feet to 36 feet, and gradually decrease toward the river. Elevations northwest of the CPA range from 33 feet to 36 feet, except for the remnants of a former BNRR spur line, which slopes down to the site from an elevation of approximately 40 feet. Southeast of the CPA, elevations generally range from 29 feet to 33 feet. The lowest elevations on site are along the southeast fence line adjacent to the former Riedel International property and in the southeast waste disposal trench.

USACE
United States Army Corps of Engineers

CRD
Columbia River Datum

NGVD
National Geodetic Vertical Datum

The McCormick & Baxter site is located at River Mile 7 on the Willamette River. Along this reach, the river flows to the northwest and is about 1,500 feet wide. Channel sounding maps for January 1991 from the **United States Army Corps of Engineers** (USACE) indicate that adjacent to the site, the channel is maintained at a width of approximately 600 feet and to a maximum depth of approximately 40 feet to 50 feet below the **Columbia River Datum** (CRD). The CRD is approximately 1.74 feet above the **National Geodetic Vertical Datum** (NGVD) 1929. The NGVD is approximately equal to MSL and appears to have been used as a control for the site topographic survey. An additional 500-foot-wide embayment is along the south portion of the McCormick & Baxter property. River depths in the embayment range from +10 feet to -25 feet NGVD. USACE maps indicate that steep slopes to the dredged navigational channel occur along a line that is essentially parallel to the flow and approximately 150 feet off the shoreline, or 300 feet from the embayment shoreline.

The elevation of the 100-year flood plain along this reach of the Willamette River is 28 feet NGVD 1929, and the elevation of the 500-year flood plain is 32 feet NGVD. A 100-year flood would rise up the bank to within a few feet of the terrace. A storm event of this magnitude occurred in February 1996. A 500-year flood would encroach onto the southeast portion of the site, flooding most of the former untreated wood storage areas southeast of the tank farm and creosote tank.

2.1.2 Geology and Hydrology

The McCormick & Baxter site is located in an area of sand fill adjacent to the Willamette River. Three hydrostratigraphic units are present at the site: the shallow, intermediate, and deep aquifer zones, which are interconnected to varying degrees depending on the location within the site.

BGS
below ground surface

The shallow, unconfined, sand fill aquifer is present across the entire site and ranges in thickness from about 5 feet to greater than 30 feet. Depth of groundwater ranges from approximately 20 feet to 25 feet **below ground surface** (BGS). The base of the shallow aquifer is defined by a silt aquitard that ranges in thickness from 0 feet to greater than 100 feet. The silt aquitard is thickest near the central portion of the site (i.e., in the TFA) and thins toward the Willamette River. At the Willamette River, the silt aquitard is truncated and a thick sequence of poorly graded sands extends from ground surface to at least 80 feet BGS. In this area, the aquifer zones are hydraulically connected and form a single, continuous, unconfined aquifer near the river boundary. Depth intervals along the river are referred to as shallow, intermediate, and deep zones of a single aquifer that is separated into distinct aquifers landward.

The intermediate aquifer comprises fine- to medium-grain alluvial sand and is present below the silt aquitard. The intermediate aquifer varies in thickness from 0 feet to greater than 50 feet. In the CPA, the intermediate aquifer is approximately 12 feet thick and is hydraulically separated from the shallow aquifer. In the TFA, the silt aquitard is greater than 100 feet thick and no intermediate aquifer is present. In other portions of the site, the intermediate zone is separated from the shallow zone by a thin silt aquitard and the intermediate zone is up to 50 feet or more in thickness. In these areas, the intermediate and deep zones are not separated by a continuous confining layer and apparently are in hydraulic connection.

The deep aquifer zone is present in all portions of the site. As described previously, the deep zone is in alluvial sands and is connected directly with the intermediate and shallow zones along the river margin. Near the center of the site, the deep zone is separated from the shallow zone by more than 100 feet of low-permeability silt. Near the bluff, the deep aquifer comprises gravel and sands of the Troutdale Formation and Catastrophic Flood Deposits.

Shallow groundwater gradients generally exist from the bluff toward the river. Intermediate and deep zone groundwater surface elevations and gradients indicate flow toward the river in these zones.

The City of Portland supplies drinking water to residential areas in north Portland, including the site. The source of this drinking water is the Bull Run Reservoir located approximately 40 miles east of Portland. This water supply is supplemented by an East Multnomah County well field (approximately 10 miles east of the site) that uses deep aquifers in the Troutdale Formation. The only current use of groundwater in the site vicinity is by the University of Portland, which operates a supply well for irrigation. This supply well is completed in the deep aquifer, which has not been affected by the site.

2.1.3 Surface Water

cfs
cubic feet per second

The Willamette River is the only surface water body at the site. Near the site, the river flows at a rate ranging from 8,300 **cubic feet per second** (cfs) in summer to 73,000 cfs in winter and is about 1,500 feet wide. The Willamette River is a major river that flows through Portland and joins the Columbia River approximately 7 miles northwest of the site. The Willamette River is not used as a drinking water source downstream of the site.

Four outfalls (Outfalls 001 through 004) were on the McCormick & Baxter property, three of which were stormwater outfalls (Outfalls 002, 003, and 004). These outfalls were removed in spring 1999 as part of the soil RA. As stated previously, following shutdown of the McCormick & Baxter facility, earthen berms were placed around stormwater collection sumps to minimize off-site discharge through these outfalls. Currently, stormwater at the site infiltrates into the subsurface.

°F
degrees Fahrenheit

2.1.4 Climate and Meteorology

The temperature in the Portland area is generally mild, with little precipitation during summer and spring. Winter generally is characterized by mild temperatures, cloudy skies, and frequent rain. Monthly average temperatures range from approximately 41 **degrees Fahrenheit** (°F) in winter to approximately 70°F in summer. Daily minimum temperatures in January average 32°F. Daily maximum temperatures in July average 79°F. Average annual precipitation for Portland is 37.6 inches, with more than 76% of this falling between October and March. Monthly average relative humidity ranges from 65% to 84%.

mph
miles per hour

Winds measured at the site average 4.7 **miles per hour** (mph). Monthly average wind speeds measured at the site are relatively constant, varying from 3 mph to 6 mph, but wind speeds are generally higher in summer than in fall and winter.

Wind directions measured at the site generally are aligned with the Willamette River Valley. The predominant wind direction through much of the year is from the north-northwest. During late fall and winter, however, winds shift so that the wind direction is generally from the southeast. This same pattern is reflected in Portland Airport data, although the directions are shifted slightly to reflect the differing orientations of the Columbia and Willamette River Valleys.

Metro
Metropolitan Service District

2.1.5 Land Use

Land use at the site has been industrial since the 1940s and has been projected to continue as industrial, or perhaps to change to recreational, in the future. Development of an industrial area is proposed at the former Riedel International property to the southeast, and development of a greenspace park is proposed by **Metropolitan Service District** (Metro) at the Willamette Cove property to the northwest. Established railroad rights-of-way are on two sides of the site, and it is anticipated that the area on top of the bluff will remain residential.

2.1.6 Rare and Endangered Species

The McCormick & Baxter property is a highly developed industrial area with little terrestrial wildlife habitat; however, numerous benthic (sediment-dwelling), aquatic, and amphibian species have been observed at the site. Two federally endangered species have been observed at the site, the peregrine falcon (*Falco peregrinus*)

CFR
Code of Federal Regulations

ESA
Endangered Species Act

ESUs
evolutionarily significant units

NMFS
National Marine Fisheries Service

and the bald eagle (*Haliaeetus leucocephalus*). The peregrine falcon recently was delisted (50 **Code of Federal Regulations** [CFR] 17, August 25, 1999) pursuant to the **Endangered Species Act** (ESA) of 1973, as amended.

The Lower Willamette River provides an adult and juvenile migratory corridor, and juvenile rearing habitat, for several anadromous fish species. Three runs of Chinook salmon, two runs of steelhead trout, and individual runs of coho and sockeye salmon occur in the area. Cutthroat trout also are present in the Willamette River, but their abundance is low. Several of the **evolutionarily significant units** (ESUs) of the Willamette River either are listed or are proposed for listing by the **National Marine Fisheries Service** (NMFS) under the ESA (50 CFR 17.11 and 17.12). These include ESUs of steelhead, Chinook, and coho. Steelhead from the Willamette River downstream of Willamette Falls are included in the Lower Columbia River ESU, listed as a threatened species in March 1998. Steelhead from Willamette River tributaries upstream of Willamette Falls are included in the Upper Willamette River ESU, proposed as a threatened species in March 1998. Spring Chinook salmon from Willamette River tributaries downstream of Willamette Falls are included in the Lower Columbia River ESU, proposed as a threatened species in March 1998. Spring Chinook salmon from Willamette River tributaries upstream of Willamette Falls are included in the Upper Columbia River ESU, proposed as a threatened species in March 1998. Coho salmon from Willamette River tributaries downstream of Willamette Falls are included in the Lower Columbia River ESU, a candidate species for listing.

2.2 Site Regulatory History

In August 1983, McCormick & Baxter performed a preliminary site investigation (AquaResources, Inc. 1983) and notified DEQ of possible off-site releases near the FWDA. Subsequently, CH2M Hill was retained by McCormick & Baxter to perform a site investigation, which was completed in 1985. The investigation report concluded that soil and groundwater contamination existed at the site, but that no emergency actions were necessary to protect off-site populations (CH2M Hill 1985, 1987).

On November 24, 1987, a Stipulation and Final Order was signed by McCormick & Baxter and DEQ, requiring McCormick & Baxter to perform several RA activities. Not all of these requirements were completed by the time the facility was closed on October 10, 1991. DEQ conducted an RI/FS from September 1990 to September 1992 (PTI 1992a, 1992b).

DEQ's notice of a proposed RA for the site was published in *Secretary of State's Bulletin* on January 1, 1993; in *The Oregonian* on January 4, 1993; and in *Between the Rivers* on March 1, 1993. Summaries of the proposed cleanup plan were mailed to the approximately 370 people on the project mailing list. Copies of the RIR and FS were available for review at the St. Johns Library and North Portland Neighborhood office. The public comment period began on January 1, 1993, and ended on March 8, 1993, after being extended one month at the request of a citizen. A public comment meeting was conducted on February 2, 1993, but no verbal testimony was received. DEQ provided written responses to received comments following the public comment period.

NPL
National Priorities List

EPA
United States Environmental Protection Agency

DEQ elected to not finalize the proposed RA at the McCormick & Baxter site in 1993 because of the pending addition of the site to the **National Priorities List** (NPL) by the **United States Environmental Protection Agency** (EPA). DEQ instead began to implement several IRAMs, which were elements of the 1993 DEQ proposed plan, while awaiting a final decision from EPA regarding inclusion of the McCormick & Baxter site on the NPL. EPA added the site to the NPL on June 1, 1994.

Since completion of the RI/FS in 1992, DEQ has conducted several IRAMs and additional site characterization. Based on implementation and/or completion of the IRAMs, collection of additional site data since the 1992 FS, and experience gained at other wood-treating sites, DEQ chose to revise the 1992 FS to incorporate new data and updated remedial alternatives. The revised FS (PTI 1995) describes the updated RA alternatives for the McCormick & Baxter site and incorporates IRAMs conducted since the 1992 FS.

The proposed plan describing DEQ and EPA's preferred remedy was issued on October 30, 1995. The public comment period began on November 6, 1995, and ended on January 15, 1996. A public meeting was conducted on November 28, 1995. After considering the comments received during the public comment period, DEQ and EPA issued the ROD, specifying the selected remedy, in March 1996. DEQ conducted public meetings on April 23 and May 29, 1996, to discuss the ROD and the selected remedy. The ROD was amended in March 1998 to revise the soil remedy from on-site treatment to off-site disposal.

2.3 Current Site Configuration

NAPL
nonaqueous phase liquid

Several IRAMs and removal actions have been conducted by DEQ contractors at the McCormick & Baxter site. Phase I of the soil RA was completed in May 1999. The final soil site cap is yet to be installed. The McCormick & Baxter property is accessed via the partially paved North Edgewater Street, which leads from Willamette Boulevard to the Union Pacific Railroad tracks at the base of the bluff. The driveway leading into the property and the parking lot are paved. The remainder of the property is unpaved, covered with gravel, or vegetated. A former shop building (used to house the TFA groundwater treatment plant) is the only original structure remaining on site. Two office trailers and an intermodal container (housing the FWDA GTS) are the only other structures remaining on site. In addition, **nonaqueous phase liquid** (NAPL) storage tanks are located in the FWDA and TFA. These tanks are located in a lined and bermed secondary containment. The entire site is fenced, and warning signs are posted on the fence around the perimeter of the site.

Utility service at the site includes water provided by the City of Portland to the office trailers, the former shop building, and several fire hydrants. Electrical service is provided by Portland General Electric Company to the office trailers, the former shop building, the FWDA GTS, and security lights mounted on several overhead poles. Two pressurized sewer lines are located on the west side of the site adjacent to the BNRR tracks. These forcemains, 20 inches and 30 inches in diameter, are 4 feet apart and protected by asbestos-bonded casing pipe, as shown on a copy of an old utility map (source unknown). These lines extend beneath the FWDA near the beach before crossing beneath the Willamette River, offset 404.5 feet upstream from the centerline of the railroad bridge (see Drawing 2). One combined sewer line is located on the east side of the site adjacent to the former Riedel International property.

3 Nature and Extent of Contamination

SQAP
sampling and quality assurance plan

The source areas and nature and extent of contamination in sediment are discussed in detail in the RIR (PTI 1992a) and ROD. A discussion of contaminant source areas and the nature and extent of contamination also is presented in the **sampling and quality assurance plan** (SQAP), which was published in August 1999 (E & E 1999b). Additional information acquired during the October 1999 and January 2001 RD sediment sampling events also are summarized (E & E 1999a and E & E 2001). This summary information forms the basis of the current conceptual site model.

3.1 Conceptual Site Model

3.1.1 Groundwater

LNAPL
lighter-than-water nonaqueous phase liquid

DNAPL
denser-than-water nonaqueous phase liquid

The main site-related contaminants in groundwater are PAHs, PCP, and metals associated with wood-treating solutions. The main source areas of the groundwater contamination include the TFA and creosote tank; the FWDA; the CPA; and, to a limited extent, a localized area in the southeast waste disposal trench and an unknown source area near MW-1. Wood-treating contaminants generally have low to moderate solubility in water, and the wood-treatment products either float on the water table or continue to sink depending on the density of the waste compared to that of the water. These relatively insoluble materials commonly are described as *NAPL.* NAPL that is lighter than water (i.e., floats) is referred to as **lighter-than-water nonaqueous phase liquid** (LNAPL), and NAPL that is heavier than water (i.e., has a higher density and sinks) is referred to as **denser-than-water nonaqueous phase liquid** (DNAPL). Because the density of LNAPL and DNAPL at this site is very close to the density of water, the oil-phase product tends to be suspended in discontinuous layers and lenses throughout the aquifer thickness. Groundwater quality at the site also has been impacted by dissolved-phase contaminants.

Releases of NAPL contaminants from the main source areas at the site, particularly the TFA and FWDA, have affected mainly the shallow aquifer. As the pure-phase NAPL has migrated toward the river, it also has spread downward vertically, affecting a layer of sand adjacent to the river. Two distinct NAPL plumes are present at the site: one in the TFA and the other in the FWDA (see Figure 3-1). These contaminant plumes contain LNAPL and/or DNAPL that consist of creosote compounds, as well as dissolved-phase contaminants.

The FWDA NAPL plume is estimated to affect approximately 4 acres of soil and 5 acres of sediment. The origin of this plume is waste oils, stormwater from system pits, and other liquid wastes that were disposed of in the FWDA. This mixture migrated as LNAPL and DNAPL, vertically to the water table (approximately 30 feet BGS) and then laterally toward the river.

The TFA plume is estimated to affect approximately 8 acres of soil and 6 acres of sediment. The origin of this plume is the former tank farm, large creosote tank, creosote retorts, butt tanks, and southeast waste disposal trench, which either had periodic spills or were used for disposal of waste oils (creosote and PCP) and other liquid wastes. This mixture migrated vertically to the water table (approximately 30 feet BGS) and then laterally toward the river, spreading as LNAPL and DNAPL. Near the beach, LNAPL has been observed as seeps at low tides and at low river stage, generally during late summer.

Contaminant flux from the shallow aquifer groundwater to river sediments still is occurring at the site downgradient of the FWDA and TFA plumes. Groundwater gradients in the shallow, intermediate, and deep zones are generally from the bluff toward the river. However, there are periodic reversals of gradient from the river to the site, near the shoreline. As previously discussed, impacted groundwater can be observed in beach seeps during late summer when the river stage is low and hydrostatic pressures decrease, allowing NAPL and impacted groundwater to enter the river sediments. Installation of an impermeable vertical barrier to mitigate migration of NAPL to river sediments is being evaluated.

3.1.2 Sediments

Based on the results of sampling conducted by PTI during the RI, the areas of contaminated sediment are located downgradient of the NAPL plumes in the TFA and FWDA. The estimated extent of sediment contamination, based on RI sampling, is shown in Figure 3-1. Samples collected as part of the 1997 Portland Harbor study yielded results that were generally lower in concentration than the results from the RI. None of the sample locations are close enough to allow a direct comparison.

Subsurface sample data indicated that contamination may extend as deep as 35 feet in heavily contaminated areas. Beach seeps and sheens observed on the river and related to bleb releases from sediment are seasonal in nature, typically occurring in late summer when the river stage is below 3 feet MSL. In addition, areas near the former creosote dock were observed to have ongoing discharges, as evidenced by sheens on the river surface.

Investigations of the former creosote dock area were conducted during the RI in order to evaluate the presence and locations of existing NAPL pool areas in the near-shore sediment, the practicability of NAPL extraction from NAPL pools located in the near-shore sediment, and the effectiveness of upland NAPL extraction efforts in preventing continued migration of NAPL into the near-shore sediment. Wells were installed in the sediment during the RI but since have been destroyed by river debris. Conclusions of these additional sediment investigations include the following:

- The only recoverable NAPL was found in sediment in an area around the former creosote dock. LNAPL thicknesses (0.5 foot to 1 foot) were measured in three sediment wells; however, no DNAPL has been measured in any of the sediment wells. The LNAPL may represent a fractionation of a mixture of NAPLs in the sediment;
- The composition of the NAPL removed from sediment well SEDW-3 included aliphatic hydrocarbons (approximately 7%) and low-molecular-weight PAHs (approximately 14%);
- Where present, NAPL appears to be found in the upper 5 feet to 7 feet of the sediment. The interval from 7 feet to 15 feet does not yield NAPL, perhaps because this depth interval has a higher percentage of silt or finer-grain sediment;
- Based on apparent difficulty in intersecting extractable NAPL pools with sediment wells, the NAPL layers apparently may be

thin and discontinuous, or migration of NAPL may be occurring along preferential pathways (i.e., differences in sediment composition from depositional differences or historical dredging, or a topographic low in the top of a silt zone in the sediment);
- Based on the limited NAPL extraction data from the near-shore sediment wells, the extent of readily extractable NAPL from sediment wells that had NAPL accumulations may be limited; and
- Discharge of NAPL (as indicated by an oily sheen on the river surface) to the sediment appears to be greatest during low river stages, when hydraulic gradients are steepest. Increases in air, soil, and water temperatures during summer may decrease the NAPL viscosity. This increase in temperature in the summer also coincides with the lowest river stages and sediment agitation caused by tidal fluctuations and river traffic, resulting in an apparent increase in NAPL discharge.

Based on the historical (RI) bioassay data, sediments at the site have significant toxicity according to Microtox and *Hyallela azteca* bioassays. Sediments causing the greatest adverse effects are distributed around the former creosote dock and upstream of the former creosote dock, along the shoreline. Sediments causing significant, but fewer, adverse effects are near the north seep and railroad bridge.

3.2 Phase 1 Remedial Design Sediment Sampling Results

Sediment at the site was sampled in 1990 as part of the RI, in 1997 as part of the Portland Harbor site investigation, and in October 1999 as part of the RD investigation. Results from the 1990 RI and the 1997 Portland Harbor site investigation are summarized in the SQAP and discussed briefly in Section 3.1. The following discussion summarizes results from the October 1999 investigation, hereinafter referred to as Phase 1 RD sediment sampling results.

cPAH
carcinogenic PAH

Thirty-nine sediment samples and four upstream reference samples were collected and analyzed for PAHs, PCP, and arsenic (see Table 3-1). Analytical results for sediment samples collected on site were evaluated against the ROD cleanup goals (see Table 3-2) and compared to analytical results from reference locations. Six of the 39 sediment samples (MBSED99-07, -08, -17, -20, -23, and -29) displayed **carcinogenic PAH** (cPAH)

μg/kg
micrograms per kilogram

results exceeding the ROD cleanup goal of 2,000 **micrograms per kilogram** (μg/kg). These sediment samples were collected in Willamette Cove immediately downstream of the BNRR bridge (MBSED99-07 and -08), along the east side of the shipping channel (MBSED99-17, -20, and -23), and southwest of the TFA (MBSED99-29; see Figure 3-1). Upstream reference sample sediment chemistry results for arsenic, PCP, and PAHs were low or nondetect (see Table 3-1).

Analytical results also were evaluated for significant adverse effects to benthic life (see Table 3-3). Significant mortality of *Chironomus tentans* test organisms was exhibited in one of the 39 sediment samples collected at the McCormick and Baxter site. This location is at the end of the former creosote dock, at the same location where the highest PAH concentrations were measured. Significantly reduced growth of *Chironomus tentans* test organisms was exhibited in five of the 39 sediment samples. Three of these five sediment samples (MBSED99-07, -17, and -20) also displayed analytical results exceeding ROD cleanup goals. The remaining three sediment samples with exceedances of ROD cleanup goals (MBSED99-08 [6,300 μg/kg], -23 [2,215 μg/kg], and 29 [2,186 μg/kg]) exhibited growth levels that were not significantly different from laboratory controls. Other factors, rather than cPAH concentrations alone, likely are responsible for adverse effects to *Chironomus tentans* test organisms.

Significant mortality of *Hyallela azteca* test organisms was exhibited in 11 of the 39 sediment samples. Only four of these 11 sediment samples (MBSED99-07, -08, -17, and -29) also displayed analytical results exceeding ROD cleanup goals. The remaining two sediment samples with exceedances of ROD cleanup goals (MBSED99-20 [6,335 μg/kg] and -23 [2,215 μg/kg]) exhibited 86.3% and 98.8% *Hyallela azteca* survival, respectively. Other factors, rather than cPAH concentrations alone, likely are responsible for adverse effects to *Hyallela azteca* test organisms.

Based on this evaluation of the bioassay results, the following general conclusions can be reached:

- High levels of PAHs were detected in samples collected where LNAPL releases are known or suspected to be occurring: near the creosote dock, downstream into Willamette Cove (trending west from the railroad bridge), and along the sediment drop-off along the harbor line;

- PAH concentrations appear to decline rapidly away from known or suspected NAPL release areas, suggesting little lateral spreading of PAH-contaminated sediments;
- Concentrations of other contaminants of concern did not exceed ROD cleanup levels, and sediment testing for PAHs is a reliable indicator to define the area to be capped and to address residual risk to threatened and endangered salmonid stocks; and
- Chironomid bioassays appear to be a more reliable indicator of acute and chronic sediment toxicity than Hyallela bioassays.

The most severe adverse effects to benthic life and/or levels of contamination were found in sediment collected from the southwest edge of the sampled area (MBSED99-12, -17, and -23).

3.3 Phase 2 Remedial Design Sediment Sampling Results

To further define the lateral extent of contamination toward the edge of the federally designated navigation channel, additional sampling was conducted in January 2001. A more complete definition of the extent of sediment contamination was required in the following areas:

- At the bottom of the slope, extending between the harbor line and the edge of the navigation channel;
- Upstream of the creosote dock and into the lagoon area; and
- Downstream into Willamette Cove along areas of inferred NAPL migration.

The parameters that were evaluated to further define the cap limits included cPAH concentrations and significant mortality of bioassay test organisms. Twenty-nine sediment samples were collected near the McCormick & Baxter site, and one upstream reference sediment sample was collected (at River Mile 24; see Tables 3-4 and 3-5). The Phase 2 sampling locations are shown in Figure 3-2 as well as the proposed cap outline that incorporates existing data.

Five sediment samples (MBSED01-07, -13, -17, -28, and -29) displayed cPAH results exceeding the ROD cleanup goal of 2,000 µg/kg. These sediment samples were collected in Willamette Cove downstream of the BNRR bridge (MBSED01-07), immediately upstream of the BNNR bridge along the east side of the shipping channel (MBSED01-13), west of the TFA along the east side of the shipping channel (MBSED01-17), and southwest of the TFA in the lagoon (MBSED01-28 and -29).

Sediment sample MBSED99-13, collected at the bottom of the slope, contained the highest cPAH concentration, 17,147 µg/kg. PAHs were not detected in the reference sediment sample (MBSED01-30).

Sediment samples also were evaluated using bioassay test methods, including percent survival of *Hyallela azteca* test organisms (10-day duration) and percent survival and growth of *Chironomus tentans* test organisms (10-day duration). Bioassay testing was performed on 17 sediment samples collected near the McCormick & Baxter site and the upstream reference sediment sample. *Hyallela azteca* exhibited significant mortality in two sediment samples collected near the McCormick & Baxter site, MBSED01-07 and MBSED01-29 (28.8% and 8.8% survival, respectively). *Chironomus tentans* also exhibited significant mortality in sediment samples MBSED01-07 and MBSED01-29 (12.5% and 0% survival, respectively). No other sediment samples exhibited significant mortality to *Hyallela azteca* and *Chironomus tentans* test organisms.

Additional data needs are described in Section 4.

Table 3-1 Remedial Design Sediment Analytical Results
McCormick and Baxter Creosoting Company, Portland Plant
Portland, Oregon

Sample Identification	Sample Depth (ft)	cPAHs (μg/kg)	Arsenic (μg/kg)	Dioxin/Furan TCDD Toxicity Equivalent (μg/kg)	Pentachlorophenol (μg/kg)
MBSED99-01	18.4	141	6,100	NA	60 U
MBSED99-02	31.5	54	5,000	NA	60 U
MBSED99-03	25.4	73	4,700	NA	60 U
MBSED99-04	40.1	1,780	3,900	NA	600 U
MBSED99-05	10.2	252	5,300	0.0011 J	60 U
MBSED99-06	48.4	10 U	2,900	NA	60 U
MBSED99-07	26.4	**3,735**	6,000	NA	600 U
MBSED99-08	3.1	**6,300**	3,500	NA	6,000 U
MBSED99-09	0.0	27	3,700	NA	60 U
MBSED99-10	0.0	391	3,400	NA	60 U
MBSED99-11	0.0	99	4,600	0.007 J	60 U
MBSED99-12	34.9	1,662	3,500	NA	60 U
MBSED99-13	0.0	749	4,300	NA	60 U
MBSED99-14	0.0	164	3,200	0.0052 J	60 U
MBSED99-15	34.8	211	4,700	NA	100 U
MBSED99-16	5.2	1,504	8,100	0.15	86
MBSED99-17	40.6	**22,560**	6,100	NA	6,000 U
MBSED99-18	0.0	99	7,000	0.068 J	60 U
MBSED99-19	0.0	156	3,900	0.0014 J	60 U
MBSED99-20	5.3	**6,335**	4,400	NA	60 U
MBSED99-21	9.3	935	5,700	0.053 J	68
MBSED99-22	0.0	220	7,700	0.06 J	60 U
MBSED99-23	36.9	**2,215**	4,300	NA	60 U
MBSED99-24	6.0	429	4,200	NA	60 U
MBSED99-25	4.4	747	4,700	0.011 J	60 U
MBSED99-26	7.0	107	4,800	NA	60 U
MBSED99-27	9.8	542	5,600	NA	100 U
MBSED99-28	0.0	65	4,700	NA	60 U
MBSED99-29	5.4	**2,186**	5,000	NA	60 U
MBSED99-30	9.9	188	4,900	NA	60 U
MBSED99-31	8.4	85	4,600	NA	60 U
MBSED99-32	7.5	197	5,600	NA	60 U

Key is at the end of the table.

Table 3-1 Remedial Design Sediment Analytical Results (Continued)
McCormick and Baxter Creosoting Company, Portland Plant
Portland, Oregon

Sample Identification	Sample Depth (ft)	cPAHs (µg/kg)	Arsenic (µg/kg)	Dioxin/Furan TCDD Toxicity Equivalent (µg/kg)	Pentachlorophenol (µg/kg)
MBSED99-33	0.0	75	11,700	0.222 J	60 U
MBSED99-34	8.9	438	5,900	NA	60 U
MBSED99-35	4.1	86	4,300	NA	60 U
MBSED99-36	35.9	10 U	4,000	NA	60 U
MBSED99-37	0.0	31	7,800	0.03 J	60 U
MBSED99-38	9.0	96	5,700	NA	60 U
MBSED99-39	4.8	123	4,000	NA	60 U
MBSED99-40	8.5	53	4,100	NA	60 U
MBSED99-41	3.5	10 U	3,300	NA	60 U
MBSED99-42	9.2	137	3,500	NA	60 U
MBSED99-43	5.1	10 U	3,000	NA	60 U
MBSED99-50 (-33 DUP)	0.0	136	11,100	0.16 J	60 U
MBSED99-51 (-16 DUP)	6.2	1,369	8,900	NA	96
MBSED99-52 (-26 DUP)	7.0	54	4,100	NA	60 U
MBSED99-53 (-09 DUP)	0.0	13	3,000	NA	60 U
MBSED99-54 (-40 DUP)	8.5	56	3,400	NA	60 U

Note: Shaded cells indicate contaminant concentration exceeding the ROD cleanup goals for sediment.
Reference locations include MBSED99-40, -41, -42, and -43.
cPAHs include benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene.

Key:

cPAHs = Carcinogenic polycyclic aromatic hydrocarbons.
DUP = Duplicate.
ft = Feet.
J = The associated numerical value is an estimated quantity because the reported concentrations were less than the contract-required detection limits or because quality control criteria limits were not met.
µg/kg = Micrograms per kilogram.
NA = Not available or analytical test not performed on this sample.
ROD = Record of decision.
TCDD = Tetrachloro-dibenzo-*p*-dioxin.
U = The material was analyzed for but was not detected. The associated numerical value is the sample quantitation limit.

ROD Cleanup Goals:

Arsenic = 12,000 µg/kg.
Pentachlorophenol = 100,000 µg/kg.
cPAHs = 2,000 µg/kg.
Dioxins/furans = 8 µg/kg.

Table 3-2 Cleanup Goals for Sediment
McCormick and Baxter Creosoting Company, Portland Plant
Portland, Oregon

Human Health Chemical of Concern	Sediment Concentration (mg/kg-dry weight)
Arsenic	12[a]
Pentachlorophenol	100[b]
cPAHs	2[b]
Dioxins/furans	0.008[b,c]
Protection of Benthic Organisms	**Verification Criteria**
Prevent exposure of benthic organisms to sediment contamination above known toxicity levels	Bioassay tests resulting in a mortality rate less than or equal to that of upstream reference locations

[a] Based on concentrations in upstream reference station.

[b] Based on an acceptable risk of 1×10^{-6} for recreational exposure scenario. Exposure to sediment is not considered relevant to occupational scenarios. Exposure under the residential scenario would be similar to that assumed for the recreational scenario.

[c] Expressed as 2,3,7,8-tetrachlorodibenzeno-*p*-dioxin toxicity equivalent concentrations.

Key:

cPAHs = Carcinogenic polycyclic aromatic hydrocarbons.
Dioxins/furans = Polychlorinated dibenzo-*p*-dioxins and dibenzofurans.
mg/kg = Milligrams per kilogram.

Table 3-3 Remedial Design Sediment Bioassay Results
McCormick and Baxter Creosoting Company, Portland Plant
Portland, Oregon

Sample Identification	*Hyallela azteca* Percent Survival	*Chironomus tentans* Percent Survival	*Chironomus tentans* Weight (mg)
MBSED99-01	91.3	78.8	1.4
MBSED99-02	95.0	78.8	1.55
MBSED99-03	**71.3**	76.3	1.4
MBSED99-04	**35.0**	82.5	1.34
MBSED99-05	75.0	81.3	1.46
MBSED99-06	82.5	86.3	1.78
MBSED99-07	**27.5**	85.0	**0.92**
MBSED99-08	**0.0**	85.0	1.19
MBSED99-09	88.8	78.8	1.35
MBSED99-10	96.3	83.8	1.12
MBSED99-11	93.8	88.8	1.12
MBSED99-12	**47.5**	92.5	1.69
MBSED99-13	95.0	87.5	**0.26**
MBSED99-14	86.3	88.8	1.28
MBSED99-15	**55.0**	92.5	1.67
MBSED99-16	92.5	95.0	1.21
MBSED99-17	**0.0**	**2.5**	**0.01**
MBSED99-18	96.3	95.0	1.47
MBSED99-19	96.3	91.3	1.68
MBSED99-20	86.3	73.8	**0.31**
MBSED99-21	96.3	76.3	0.96
MBSED99-22	77.5	88.8	1.17
MBSED99-23	98.8	70.0	1.08
MBSED99-24	72.5	86.3	1.9
MBSED99-25	91.3	85.0	1.84
MBSED99-26	**70.0**	90.0	1.87
MBSED99-27	**61.3**	95.0	1.88
MBSED99-28	**71.3**	88.8	1.22
MBSED99-29	**63.8**	81.3	1.85
MBSED99-30	85.0	92.5	1.78
MBSED99-31	72.5	85.0	1.82
MBSED99-32	86.3	90.0	1.46
MBSED99-33	82.5	90.0	1.5
MBSED99-34	91.3	85.0	1.06
MBSED99-35	87.5	88.8	1.28
MBSED99-36	92.5	91.3	1.26

Key is at the end of the table.

Table 3-3 Remedial Design Sediment Bioassay Results (Continued)
McCormick and Baxter Creosoting Company, Portland Plant
Portland, Oregon

Sample Identification	*Hyallela azteca* Percent Survival	*Chironomus tentans* Percent Survival	*Chironomus tentans* Weight (mg)
MBSED99-37	82.5	91.3	**1.15**
MBSED99-38	87.5	93.8	1.04
MBSED99-39	97.5	88.8	1.23
MBSED99-40	97.5	**62.5**	1.2
MBSED99-41	91.3	76.3	1.28
MBSED99-42	98.8	68.8	1.19
MBSED99-43	97.5	85.0	1.56
Laboratory control (10/19/99)	NA	76.9	1.26
Laboratory control (11/1/99)	86.3	NA	NA
Sediment control (11/1/99)	96.3	NA	NA
Laboratory control (11/2/99)	NA	79.4	1.05
Sediment control (11/9/99)	81.3	NA	NA
Laboratory control (11/9/99)	83.8	NA	NA

Note: Shaded cells indicate a statistically significant reduction from laboratory control at p less than 0.05 using Wilcoxon two-sample test.
Reference locations include MBSED99-40, -41, -42, and -43.

Key:

mg = Milligrams.
NA = Not available. Results shown are only for bioassay test performed on that date.

Table 3-4 Phase 2 Remedial Design Sediment Analytical Results, January 2001
McCormick and Baxter Creosoting Company, Portland Plant
Portland, Oregon
(µg/kg)

Sample Identification	cPAHs	HPAHs	LPAHs	Total PAHs	LPAH/HPAH
MBSED01-01	204	500	93	593	0.2
MBSED01-02	116	306	666	972	2.2
MBSED01-03	195	420	44	464	0.1
MBSED01-04	218	452	52	504	0.1
MBSED01-05	137	370	57 U	370	NA
MBSED01-06	883	1,600	403	2,002	0.3
MBSED01-07	**9,980**	44,790	82,101	126,891	1.8
MBSED01-08	67	138	13 U	138	NA
MBSED01-09	724	1,594	546	2,140	0.3
MBSED01-10	32	80	13 U	80	NA
MBSED01-11	13 U	51	13 U	51	NA
MBSED01-12	13 U	13 U	13 U	13 U	NA
MBSED01-13	**17,147**	82,097	173,569	255,666	2.1
MBSED01-14	13 U	13 U	13 U	13 U	NA
MBSED01-15	13 U	13 U	13 U	13 U	NA
MBSED01-16	13 U	13 U	13 U	13 U	NA
MBSED01-17	**2,028**	3,707	981	4,688	0.3
MBSED01-18	1,101	2,584	1,049	3,633	0.4
MBSED01-19	47	92	13 U	92	NA
MBSED01-20	1,003	2,807	3,214	6,021	1.1
MBSED01-21	137	257	49	306	0.2
MBSED01-22	1,274	4,155	1,918	6,073	0.5
MBSED01-23	401	922	154	1,076	0.2
MBSED01-24	843	1,572	530	2,102	0.3
MBSED01-25	440	916	229	1,145	0.3
MBSED01-26	967	2,243	772	3,015	0.3
MBSED01-27	96	183	19	202	0.1
MBSED01-28	**2,723**	7,031	9,442	16,472	1.3
MBSED01-29	**11,133**	37,543	39,470	77,013	1.1
MBSED01-30	13 U	13 U	13 U	13 U	NA
MBSED01-40 (Duplicate of MBSED01-03)	310	606	64	670	0.1
MBSED01-41 (Duplicate of MBSED01-13)	**14,020**	82,320	205,900	288,220	2.5
MBSED01-45 (Duplicate of MBSED01-23)	544	1,328	553	1,881	0.4

Key is on the next page.

Note: Shaded cells indicate contaminant concentration exceeding the ROD cleanup goal for sediment.
Reference locations include MBSED01-30.
cPAHs include benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene.
HPAHs include fluoranthene, pyrene, benzo[a]anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, and benzo(ghi)perylene.
LPAHs include naphthalene, acenaphthalene, acenaphthene, fluorene, phenanthrene, and anthracene.

Key:

cPAHs = Carcinogenic PAHs.
HPAHs = High-molecular-weight PAHs.
LPAHs = Low-molecular-weight PAHs.
µg/kg = Micrograms per kilogram.
µg/L = Micrograms per liter.
NA = Not available or analytical test not performed on this sample.
PAHs = Polynuclear aromatic hydrocarbons.
ROD = Record of decision.
U = The material was analyzed for, but was not detected. The associated numerical value is the sample quantitation limit.

ROD Cleanup Goal:

cPAHs = 2,000 µg/kg.

Table 3-5 Table 3-5 Phase 2 Remedial Design Sediment Bioassay Results; January 2001; McCormick and Baxter Creosoting Company, Portland Plant; Portland, Oregon

Sample Identification	*Hyallela azteca* Percent Survival	*Chironomus tentans* Percent Survival	*Chironomus tentans* Weight (mg)
MBSED01-01	86.3	75.0	1.57
MBSED01-05	81.3	72.5	1.42
MBSED01-07	**28.8**	**12.5**	**0.30**
MBSED01-09	83.8	56.3	1.06
MBSED01-11	87.5	63.8	1.18
MBSED01-12	67.5	52.5	1.31
MBSED01-15	81.3	73.8	2.01
MBSED01-16	91.3	82.5	1.76
MBSED01-18	81.3	75.0	1.47
MBSED01-19	78.8	86.3	1.43
MBSED01-21	80.0	76.3	1.68
MBSED01-22	88.8	65.0	1.04
MBSED01-24	86.3	65.0	1.15
MBSED01-26	80.0	51.3	**0.62**
MBSED01-27	82.5	77.5	1.31
MBSED01-28	90.0	68.8	1.05
MBSED01-29	**8.8**	**0.0**	NA
MBSED01-30	90.0	68.8	1.59
Laboratory Control (*H. azteca*)	87.5	NA	NA
Laboratory Control 1 (*C. tentans*)	NA	71.3	1.39
Laboratory Control 2 (*C. tentans*)	NA	70.0	1.26

Note: Shaded cells indicate a statistically significant reduction from laboratory control at p less than 0.05 using Wilcoxon two-sample test. Reference locations include MBSED01-30.

Key:

mg = Milligrams.
NA = Not available. Results shown are only for bioassay test.

Note: This page is
intentionally left blank.

749.0H04.00.02\OH4F3_1B.DWG\M.WHITNAUER-ENGR\B.MORRIS-AUTOCAD\06-30-99\SEATTLE.WA.

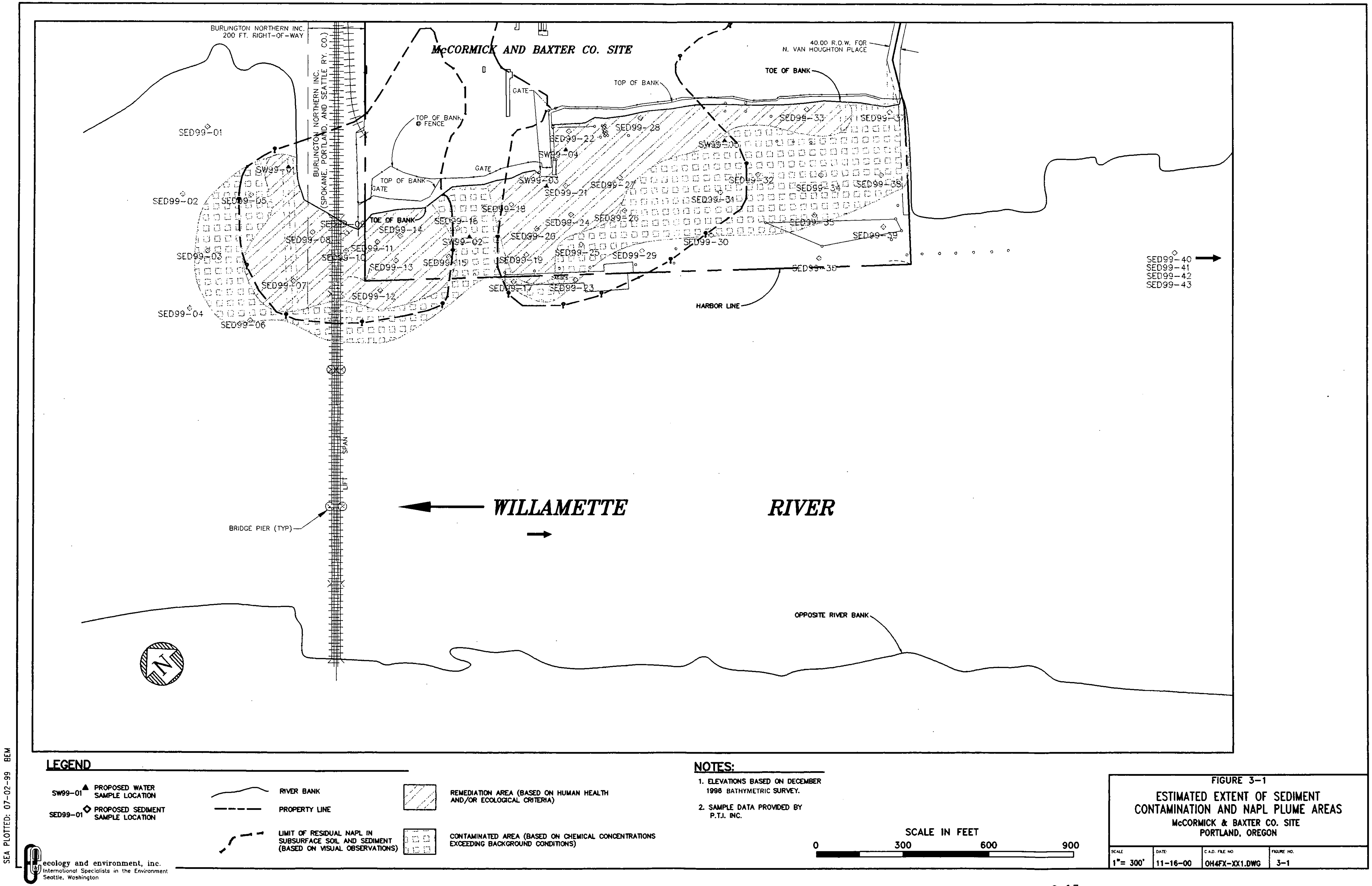
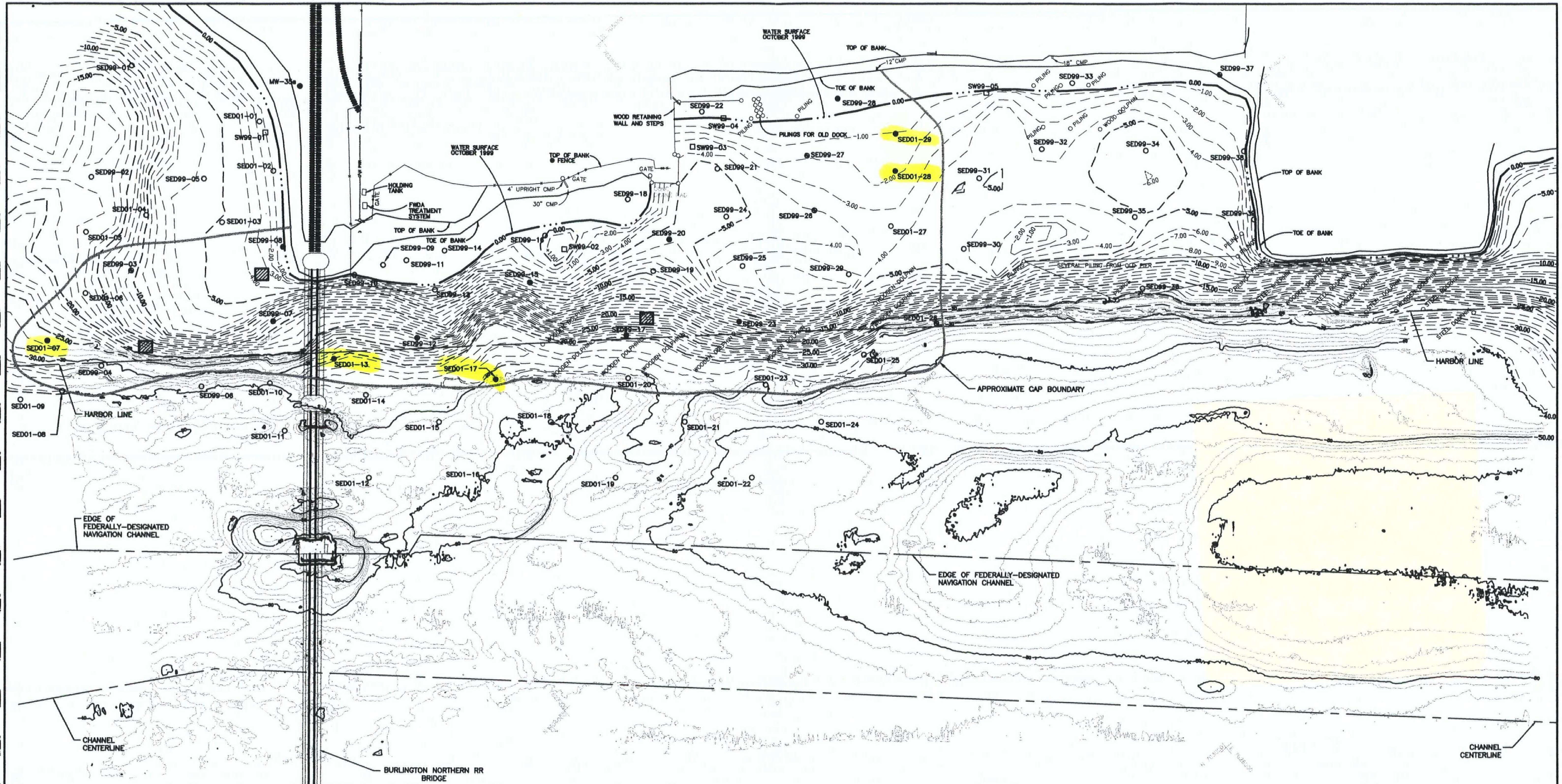


FIGURE 3-1
ESTIMATED EXTENT OF SEDIMENT CONTAMINATION AND NAPL PLUME AREAS
McCORMICK & BAXTER CO. SITE
PORTLAND, OREGON

SCALE	DATE:	C.A.D. FILE NO.	FIGURE NO.
1"= 300'	11-16-00	OH4FX-XX1.DWG	3-1

I:\FROMNT\749.0A01.00.11.01\BASIS_OF_DESIGN\0A01F3_2E.DWG\M.WITNAUER-ENG'R\B.MORRIS-AUTOCAD\02-21-01\SEATTLE,WA



NOTES

This drawing represents a bathymetric survey conducted by David Evans and Associates, Inc..

Date of survey: October 21, 1999.

Horizontal positions were acquired with a combined Inertial and Differential Global Positioning System (DGPS).

Horizontal Datum: North American Datum of 1983 (NAD83), State Plane Coordinate System (SPCS), Oregon North Zone (International Feet).

Vertical Datum: Columbia River Datum (CRD). Units are in feet.

Gauge Location: Gauge located at the Gunderson pier.

Multibeam depths were acquired with a Reson Seabat 8101 Bathymetric Sonar System. Integrated in Triton Isis with a TSS POS M/V positioning and motion reference sensor. Single Beam depths were acquired with an Innerspace 448 Echosounder.

A sound velocity profile was conducted periodically during the survey with a SEACAT SBE 19 CTD.

LEGEND

5 FOOT CONTOUR
2 FOOT CONTOUR
1 FOOT CONTOUR (estimated)
NAD83 OREGON NORTH ZONE GRID
MOORING DOLPHIN
RAILROAD TRACKS

PHASE 1 (10/99) & PHASE II (01/01) ANALYSES

SED99-01 SED01-01 — SEDIMENT SAMPLE LOCATION THAT DID NOT EXCEED EITHER cPAH (2000 ug/kg) OR BIOASSAY CRITERIA.

SED99-02 SED01-02 — SEDIMENT SAMPLE LOCATION THAT EXCEEDED BOTH cPAH (2000 ug/kg) AND BIOASSAY CRITERIA.

SED99-03 SED01-03 — SEDIMENT SAMPLE LOCATION THAT EXCEEDED ONLY BIOASSAY CRITERIA.

SED99-04 SED01-04 — SEDIMENT SAMPLE LOCATION THAT EXCEEDED ONLY cPAH (2000 ug/kg) CRITERIA.

SW99-01 — PHASE I SURFACE WATER SAMPLE LOCATION (10/99).

SUBSURFACE CORING LOCATION FOR NAPL IDENTIFICATION.

APPROXIMATE CAP BOUNDARY BASED ON CONCEPTUAL SITE MODEL.

NAVIGATION CHANNEL AND HARBOR LINE TAKEN FROM USACE, PORTLAND DISTRICT, CONSTRUCTION-OPERATIONS DIVISION DRAWING NUMBER WR-4-98 (20 MARCH 2000)

SCALE IN FEET
0 100 200 300

ecology and environment, inc.
International Specialists in the Environment
Seattle, Washington

DESIGNED BY: J. MONTGOMERY
CHECKED BY: P. GEIGER
DRAWN BY: B. MORRIS
APPROVED BY XXXXXXX

FIGURE 3-2
PROPOSED SEDIMENT CAP BOUNDARY BASED ON BIOLOGICAL ANALYSES AND cPAH CONTAMINATION

Mc CORMICK & BAXTER CREOSOTING CO. PORTLAND, OREGON

SCALE	DATE ISSUED	CAD FILE NO.	FIGURE NO.
NOTED	02-21-01	0A01F3-2E.DWG	3-2

Why is cap boundary drawn as is? - in W. Cove area

Note: This page is intentionally left blank.

4 Remedial Design Objectives and Data Gaps

This section briefly describes the selected remedy and cleanup goals for sediment and provides a discussion of the RD objectives and data needs for the sediment remedy.

4.1 Selected Sediment Remedy

The selected remedy for sediment includes capping areas that contain site contaminants above human health and ecological risk-based protective levels or that exhibit significant biological toxicity in the near surface. Additional major components of the sediment remedy, as specified in the ROD, include:

- Sampling of the surface sediment to determine contaminant concentrations and the level of attenuation of contaminant concentrations and toxicity since completion of the RI sediment monitoring and facility closure in 1991;
- Collection of Willamette River hydrodynamic data necessary for effective cap design and control of cap erosion;
- Coordination in the timing of the placement of the cap with the effectiveness evaluation of the groundwater remedy;
- Long-term monitoring and maintenance of the cap and surrounding areas following cap installation; and
- Implementation of institutional controls to ensure that the cap integrity is maintained.

The cap will be placed over sediment that exceeds human health and ecological risk-based criteria or that exhibits significant biological toxicity.

Based on the results of the October 1999 and January 2001 RD sediment sampling events and the current conceptual site understanding, it is estimated that the cap will cover approximately

17 acres and will extend along the shoreline from the former creosote dock, under the railroad bridge, and just downstream into Willamette Cove to the north. The sediment cap will be tied into the upland soil cap. To facilitate the tie-in, the steeply sloping bank near the shoreline will be regraded to a maximum slope of 3 horizontal feet per 1 vertical foot (3H:1V). The cap will extend into the river to the base of the steeply sloped area at approximately the 40-foot depth line (see Drawing 3) and will terminate at least 100 feet from the east edge of the federally designated navigation channel. Within the probable extent of the cap are structures such as abandoned pilings and the submerged parts of the creosote pier that must be removed or otherwise addressed. Additionally, the pilings or footing of the BNRR bridge are within the estimated extent of the cap. The cap will consist of sand or other readily available clean fill suitable for placement in water. The cap will be approximately 3 feet thick and may be armored in areas susceptible to erosion by river currents or vessel-induced wave action. The armoring will be selected to minimize its impact on the salmonid species and to facilitate transition to the upland soil cap.

4.2 Data Needs

E & E, in coordination with USACE, reviewed existing data and documents, including the draft *Sediment Remedial Design Sampling Data Summary Report* (E & E 1999a), the ROD, and the RIR. The results of this review, which are summarized in a USACE August 29, 2000, letter to DEQ, were used to identify data needs in order to proceed with the design of the sediment cap. The RD data needs and data collection rationale for the sediment remedy are discussed below in the order in which they appear in USACE's letter. These needs were addressed as documented in the final sediment SQAP amendment (E & E 2000). The results are summarized in the final *Sediment Remedial Design Sampling Data Summary Report* and incorporated into the cap design.

4.2.1 Cap Footprint

The preliminary cap boundary, as depicted in Drawing 3, is based on the results of the sediment RD sampling activities and the current conceptual site understanding. Those areas within the preliminary cap boundary include sample locations that exceeded the numerical cleanup goal for cPAHs and/or that had significant acute or chronic sediment toxicity to benthic organisms, and included areas of known NAPL migration (e.g., seeps) as described in Section 3.1. RD Phase 2 sampling reduced the uncertainty

SVOCs
semivolatile organic compounds

regarding the cap limits for the design report. In this phase of sampling, surface sediment samples were collected and analyzed for **semivolatile organic compounds** (SVOCs), including PAHs and PCP, and toxicity testing using *Hyallela azteca* and *Chironomus tentans* bioassays was performed. The analytical results were evaluated relative to the ROD criteria. The results are summarized in the final *Sediment Remedial Design Sampling Data Summary Report* and were incorporated into the cap design.

4.2.2 Submerged Utilities

Many existing utilities are in the river within the preliminary cap boundary. These include communications cables associated with the railroad bridge, an abandoned natural gas pipeline, and two sewer forcemains. The City of Portland plans to install an additional forcemain and is evaluating routes that include one within the preliminary cap boundary. E & E and DEQ acknowledge the need for coordination with relevant entities throughout the design process. E & E and DEQ have met with the City of Portland and the City's contractors to discuss the potential impacts of the proposed alignment of the new sewer forcemain on contaminated sediments. E & E and DEQ will continue these discussions throughout the design process.

4.2.3 Floodway and Flood Storage Issues

The designed cap will encroach into the Willamette River floodway. The cap must meet local and federal regulatory requirements governing encroachment of the floodway. A floodway encroachment analysis of the proposed cap will be performed. To support this data need, additional hydrographic surveying has been conducted within the proposed cap boundary. Details regarding the floodway encroachment evaluation and modeling and the additional hydrographic surveying are presented in Section 5.1 of the final sediment SQAP amendment. Preliminary information from the hydraulic modeling and floodway analysis was used as a basis for portions of the cap design discussed in Section 5.4 of this basis of design report.

4.2.4 Analysis of Hydraulic Forces

The designed cap will be subject to many forces that could transport placed cap materials, thereby decreasing the effectiveness of the remedy. The primary hydraulic forces that could impact the cap include high-velocity currents, wind-driven wave action, and vessel-induced waves and propeller wash. Including armoring in the design of the cap will mitigate these impacts. An analysis of flood-induced water velocities has been performed by applying a two-dimensional flow model to the site in order to develop river current information. Specific areas where flood-induced water velocities could impact the cap include the vicinity of the submerged bridge piers (because of scour) and along the shoreline in the vicinity of the bridge (because of channel narrowing). Water velocity information has been generated throughout the proposed capping area, and the information has been used to recommend armoring alternatives. The stability of the armoring will be analyzed against other hydraulic forces, including wind waves, waves due to vessel wake, and vessel-induced propeller wash. The amount of armoring required for flood-induced water velocities may be adjusted in response to the effects of these other hydraulic forces. Preliminary information from the hydraulic modeling and floodway analysis was used as a basis for portions of the cap design discussed in Section 5.4.

4.2.5 Feasibility and Methods of Capping Steep Slopes

The cap design will require construction on steep slopes along the shoreline. Slope stability analyses of the in situ sediments and potential cap materials have been and will be conducted to address placement and long-term stability. Results of these analyses will be used to formulate recommendations regarding construction practices to address short-term stability and relating to design slopes to address long-term stability. Details regarding the geotechnical analysis, including the collection of sediment core samples, are presented in Section 5.3 of the final sediment SQAP amendment. Preliminary information from the geotechnical study was used as a basis for portions of the cap design discussed in Section 5.4 and is presented in Appendix A.

4.2.6 Cap Effective Thickness to Chemical Diffusion and Lighter-than-Water Nonaqueous Phase Liquid Permeation

There is uncertainty regarding the ability of the cap to prevent upward migration of chemicals and LNAPL through the cap. The uncertainty can be reduced through the evaluation of diffusion and advection modeling. The data needs for chemical diffusion and advection modeling are the model input values. Most of these values are available or may be reasonably assumed. Upon identification of sources of potential cap material, sampling and analysis of that material for suitability for use as a cap will be performed.

In addition, sediment cores were collected for LNAPL characterization in January 2001 (see next paragraph), and sediment pore water was obtained at that time. Sediment pore water can be measured directly for SVOC concentrations and dissolved organic carbon. The measured values will be used as inputs into the chemical diffusion and advection modeling and to check calculated concentrations of dissolved SVOCs based on equilibrium partitioning calculations.

The uncertainty regarding LNAPL permeation through the proposed cap requires an evaluation of the existing LNAPL in sediments and the hydraulic properties of the cap material. The data needs for LNAPL permeation modeling are the model input values. Specific data regarding the constituency of the LNAPL must be obtained because there are no reasonable estimates in literature. LNAPL will be collected by physical separation from continuous cores of sediment that are obtained in areas of known NAPL occurrence based on sediment RD Phase 1 observations. NAPL will be measured for density, viscosity, and interfacial tension. Porosity and saturation permeability curves will be estimated from the material type, and pore water chemistry data will be collected. Model input parameters relating to the cap materials will be estimated from literature or other projects. The results of these analyses will be used to evaluate the protectiveness and selection of the cap material.

These needs were addressed as documented in the final sediment SQAP amendment. The preliminary results are summarized in the final *Sediment Remedial Design Sampling Data Summary Report* and will be incorporated into the cap design.

5 Basis of Design

A detailed description of the design components is presented in the following sections. These activities include:

- Removal of the bulkhead, pilings, dolphins, and creosote pier underpinnings, and abandonment of selected shoreline monitoring wells; and
- Placement of the sediment cap.

The remainder of Section 5 describes these activities and includes a discussion of the objectives, design provisions, technical approaches, and construction requirements.

5.1 Construction Preparation and Mobilization

The contractor (procured by DEQ to implement the bulkhead removal and sediment cap activities) will be required to prepare the following preconstruction plans:

- **Contractor site safety plan** (CSSP),
- **Construction operations plan** (COP),
- **Construction quality control plan** (CQCP),
- **Disposal, transportation, and placement plan** (DTPP), and
- Construction schedule.

These plans will be submitted to DEQ for approval before initiation of any mobilization, site preparation, or construction activities. The CSSP will ensure that all personnel comply with the basic provisions of the **Occupational Safety and Health Administration** (OSHA) standards (29 CFR 1910) and General Construction Standards (29 CFR 1926), including the OSHA *Hazardous Waste Operations and Emergency Response, Interim Final Rule* (29 CFR 1910.120). The COP shall identify personnel, equipment, and construction procedures to be utilized in carrying

CSSP
contractor site safety plan

COP
construction operations plan

CQCP
construction quality control plan

DTPP
disposal, transportation, and placement plan

OSHA
Occupational Safety and Health Administration

ODFW
Oregon Department of Fish and Wildlife

out the project requirements. The CQCP will indicate the measures that will be implemented to ensure quality workmanship and products. The DTPP will describe details of the disposal of the demolished items, provide the source of and means to transport the sediment capping materials, and explain the method(s) that will be utilized to place the capping materials. The construction schedule will provide a detailed schedule for the site work, with subschedules of related activities that are essential to the construction process. The construction schedule will be prepared and maintained throughout work activities to ensure completion of the project within the in-water construction windows established by the **Oregon Department of Fish and Wildlife** (ODFW).

Mobilization will include transportation to the site and staging, if necessary, of all equipment, materials, and supplies required to complete the specified sediment remedy. Site activities are expected to include preparation of shore-side support systems, establishment of offshore construction controls, and installation of health and safety controls.

5.2 Demolition and Debris Removal

As part of the sediment cap activities, specific structures and debris remaining on site will be demolished and disposed of or recycled. This demolition and debris removal component of the sediment remedy will enhance the integrity of the cap and return the site to a more natural state. Portions of the demolition may be concluded in advance of the capping activity. Sections 5.2.1 through 5.2.4 describe components to be removed and the rationale, locations, and procedures to do so. Drawing 2 shows the limits of demolition.

5.2.1 Monitoring Wells

Selected shoreline wells will be abandoned, because they are in the area of the cap that will extend up the shore to the toe of the bank. These wells include MW-25, -26, -27, -28, -29, and -30. In addition, landward monitoring wells in the bulkhead vicinity will be abandoned to facilitate regrading of the area. These wells include TM-1, -2, -3, -4, and -5.

The monitoring wells at the site have exhibited groundwater contamination. According to Oregon Department of Water Resources regulations, all monitoring wells that have exhibited groundwater contamination must be abandoned by removing the entire well and all well material. The monitoring wells will be abandoned using a hollow-stem-auger drill rig. The following well abandonment procedures will be conducted at the site:

- The surface monument around the well will be removed;
- The well will be over-reamed using an auger flight with an outside diameter greater than the well casing. The auger will be placed over the well at ground surface, and the auger will be advanced to the exact depth reached during the initial well installation;
- All well material, including **polyvinyl chloride** (PVC), filter pack, and bentonite grout, will be removed during the drilling process;
- Once the auger reaches the borehole depth corresponding to the depth drilled during installation of the well, a 5% bentonite grout will be placed in the auger flights; and
- The grout will be brought to the ground surface as the auger flight is removed from the borehole.

PVC
polyvinyl chloride

Solid waste (e.g., PVC well casing and filter pack) will be disposed of at an approved off-site landfill.

5.2.2 Pilings and Dolphins

Pilings, dolphins, and submerged parts of the former creosote pier are located throughout the area to be capped. Each dolphin is a group of up to 20 pilings. An estimated eight dolphins and 550 individual pilings are located within or just adjacent to the cap area. Most are located on the steepest portion of the slope, as shown in Drawing 2. If the pilings and dolphins are left in place, the penetration of these timbers through the cap could provide a preferred flow path for transport of contaminants and NAPL from within the existing sediment up through the cap, and the treated pilings themselves could be a source of contamination. The physical presence of multiple pilings also would complicate cap placement. The pilings, dolphins, and creosote pier remnants will be removed by sawing or "snipping" off each one near the sediment surface, and they will be transported for reuse (if appropriate) or for disposal at an appropriate landfill. Removal by pile pulling is not recommended because of the greater potential for contaminant release from the sediment as well as the increased turbidity by contaminated sediments that would be expected with this method. The removal is to precede placement of the capping materials.

Removal of the dolphins and pilings will discourage inappropriate use of the site, such as the mooring of large vessels. Also, the removal could create more favorable conveyance conditions, in terms of storage capacity and river current pathways, at that reach in the Willamette River during flood events.

5.2.3 Bulkhead

The bulkhead is a remnant of the former creosote pier. It also serves as a topographical transition to the embayment at the site. Analyses of the soil samples collected just behind (landward of) the bulkhead in November 2000 will indicate whether the soil has contaminants above action levels.

The bulkhead is to be removed to re-establish a more natural condition. The area will be graded to provide a bank that will join the existing banks. The newly created bank will provide a more efficient means for wave energy dissipation during high water conditions than the current vertical bulkhead surface. This removal activity will occur before capping to provide the final bank configuration against which the cap will abut.

5.2.4 Bank Regrading

The banks at the shoreline are steep and pose complications for the transition from the sediment cap to the future soil cap. Regrading the bank upslope from the sediment cap to a maximum slope of 3H:1V will provide a stable slope for both caps. The regraded slopes will ensure that future soil cap construction will not jeopardize the integrity of the sediment cap. The regraded slope will be seeded as a temporary measure until the soil cap is installed. A benefit to this activity will be that the site will conform more closely to the Greenway plan.

5.3 Off-Site Transportation and Disposal

Two primary modes of off-site waste transportation are expected to be employed by the contractor: truck and barge. The contractor will decide whether a combination of modes is most appropriate or cost-effective. Supporting information and documentation will be submitted by the contractor with the required DTPP, subject to approval by DEQ. The DTPP will be submitted by the contractor before mobilization. The primary items to be required in the DTPP are a detailed description of the proposed transportation means, a transportation schedule, applicable standards and regulations, safety requirements, loading and unloading procedures, hauling procedures, transportation routes, traffic estimations, vehicle decontamination, spill prevention and response procedures, and bill of lading and manifest preparation procedures. The DTPP also will include an off-site accident contingency plan detailing response and cleanup procedures in the event of an off-site transportation accident.

The contractor will be responsible for ensuring that all vehicles entering and leaving the site comply with applicable safety requirements, and the transportation of all materials will comply with all applicable local, state, and federal regulations. All material will be handled, loaded, and transported in a manner that prevents spillage or contamination on site or off site. The contractor will be responsible for soil and debris spilled on site or off site during all loading or transit activities. Contaminated debris (i.e., demolished well materials) will be loaded into suitable lined trucks and covered with a tarpaulin. Nonhazardous demolition debris will be placed in suitable containers or trucks and secured to ensure that no items are lost during transport.

The contractor will dispose of the wastes resulting from on-site activities at permitted treatment, disposal, or recycling facilities. Bidders will be required to submit a list of proposed disposal facilities with their bid.

5.4 Capping

Sections 5.4.1 through 5.4.4 describe various elements of the cap design and construction, and two alternatives for the basic design are presented.

5.4.1 Design

As stated previously, the objective of the capping activity is to prevent humans and aquatic organisms from directly contacting the contaminated sediment. The ROD indicates that this will be accomplished through placement of a 3-foot layer of sand. The cap design is guided by two documents: EPA's *Assessment and Remediation of Contaminated Sediments (ARCS) Program: Guidance for In-Situ Subaqueous Capping of Contaminated Sediments* (Palermo et al. 1998), and USACE's *Guidance for Subaqueous Dredged Material Capping* (USACE 1998). Recent capping projects also provide insight into the activity at the McCormick & Baxter site. An upriver site near the Oregon Museum of Science and Industry, referred to as *Station L*, was capped in 1990, and a capping project is under construction at the Wyckoff/Eagle Harbor Superfund site near Seattle, Washington.

Besides physical isolation, proper cap design considers the physical stability of the contaminated sediments and the ability of the contaminants to enter surface sediments or the water column. The calculated layer thicknesses to address each component are additive. The final cap thickness will be the sum of all the protective components.

cm
centimeters

Physical isolation is achieved with a thickness that is deeper than the burrows of benthic organisms. This bioturbation depth depends on the local organisms but often is chosen to be 10 **centimeters** (cm) in the absence of specific benthic organism information. However, studies in the Portland Harbor area have identified only two benthic organisms: oligochaetes and midges (family *Chironomidae*). The former burrow less than 3 cm into the sediment, while the latter burrow to a depth of 1 cm (Diener and Moore 2001). On this basis, a sand thickness of 6 inches would provide conservative protection from bioturbation impacts.

HWA
HWA Geosciences, Inc.

Chemical isolation is a function of the contaminant; of the properties of the sediment in which it is found; and of the cap design, including the material and the cap dimensions. The additional analyses that will provide data for the existing sediment are yet to be conducted but will be incorporated into the final design. However, preliminary data are the basis for an initial choice of a 2-foot-thick sand layer. Because the existing sediment is poorly graded sand and silty sand (**HWA Geosciences, Inc.** [HWA] 2000a) and the capping material will be similar, little consolidation of either material is anticipated. Consequently, advection of the contaminants due to pore water extrusion is not expected to be a major factor in the final cap thickness. However, results from permeation modeling for movement of PAHs and LNAPL through the cap via consolidation and groundwater will be incorporated into the final design.

The areal limits of the cap are established to cover areas of contamination where cPAH levels exceed the ROD cleanup goal of 2,000 μg/kg or where significant effects to benthic organisms occur as measured by bioassay results. Sampling results from the Phase 2 sampling event led to modification of the preliminary cap outline on the basis of PAH contamination levels and bioassay results. Cap components will extend beyond these limits to provide stability and protection for the edges of the cap.

Issues of concern for the physical stability of the cap include slopes, currents, waves, and seismicity. Steep slopes run parallel to the shoreline through the area to be capped from approximately the 0 to -30 elevation CRD. Slopes in this area average 2.5H:1V, which preliminary analyses show to be stable for the sediment (HWA 2000a; see Appendix A). The imported capping material will be of equal or greater strength, and all slopes will be flattened with fill to at least 2.5H:1V, which may require additional material to achieve the design inclination.

fps
feet per second

OBA
Ogden Beeman and Associates

Waves are created by vessel wake and wind. Bottom velocities generated by propeller action were estimated to be as high as 6.2 **feet per second** (fps) at 4- to 6-foot depths (**Ogden Beeman and Associates** [OBA] 2000a). At water depths of 6 feet to 8 feet and 16 feet to 18 feet, a velocity of 5.4 fps was predicted to be generated by various classes of vessels (see Appendix B). A wave height of 3.3 feet and a period of 3 seconds will be used to evaluate bankline stability, and the recommended material for these waves will extend to a minimum water depth of 7 feet below CRD.

FEMA
Federal Emergency Management Agency

The river current also imposes stability requirements upon the cap. Currents as great as 5 fps in the railroad bridge vicinity are predicted from a preliminary 2-dimensional hydraulic model using existing conditions and the **Federal Emergency Management Agency** (FEMA) 1% flood event flows (OBA 2000b). The current velocities in this area increase to 6 fps for the 0.2% (500-year) flood event flows (OBA 2001).

D_{100}
100% size of graded material

To protect the cap against wave and current action, a gravel or armor layer will be placed at selected areas. The size of the armor was calculated using Appendix A from EPA's *Guidance for In-Situ Subaqueous Capping of Contaminated Sediments*. The calculated maximum **(100%) size of the graded material** (D_{100}) was 2 inches for the deep river currents and 4 inches for areas impacted by waves. To armor against river currents, fish-friendly gravel of a 6-inch-minus size will be used in a 12-inch layer.

At the wave-impacted areas of -7 feet CRD or shallower, a more protective armor layer is recommended. USACE recommends 9 inches as a minimum D_{100} value. Furthermore, guidance recommends that for placement under water, a design thickness of 1.5 times the D_{100}, or 13.5 inches, should be used. In recent years, other revetment options have been introduced, and they are recommended for this site. A shoreline revetment such as interlocking concrete blocks minimizes the necessary thickness to remain protective. The blocks are 9 inches thick, and the interstices of the blocks can be filled with sand, gravel, or vegetation, which provide ecological and aesthetic benefits.

In those areas with steep slopes, the slope can be flattened by thickening either the sand or gravel layer to produce the design slope of 2.5H:1V.

Finally, the seismic stability of the sediment was reviewed. The potential for earthquake-induced liquefaction is considered to be moderate. The potential impacts include lateral spreading and settlement of the native sands within the upper 25 feet (HWA 2000a). No mitigation measures are included in the design to address seismic issues, but the subject will be considered in the operation and maintenance procedures discussed in Section 5.6.

5.4.2 Material

The capping material may come from multiple sources. The sand layer will be at least 2 feet thick. Columbia River sands are a possible source of material. Contractors are able to obtain permits from USACE for dredging material from channels near the Portland area. This material is mostly sand and therefore may meet the criterion of having strength equal to or greater than that of the contaminated sediment. Specifications for the material will require, as additional criteria, that the fines component be adequate to retard contaminant travel through the cap by adsorption, but not excessive so that turbidity during placement can be minimized. The parameters for organic content will be based on the outcome of the advection modeling. A material with a higher organic content is able to intercept and retard the migration of certain contaminants. Upland sources also could provide the material. Transportation to the site is expected to be primarily by barge. Capping the exposed shoreline sediment, depending on the river level, may require that the material be transported by truck or be moved from a barge by a conveyor.

The gravel layer will be at least 12 inches thick. The material will have similar criteria in terms of fines and organic content for the same reasons as discussed previously. The gravel should be angular and will come from an upland source. Transport is expected to be comparable to that for the sand methods.

Minimum thicknesses for cap layers discussed in this report provide required protection. For in-water placement, USACE guidance suggests that the specified thickness be increased by 50%.

5.4.3 Placement

The cap material is to be placed in a manner that provides the necessary layer thicknesses while minimizing resuspension of the contaminated sediment. The contract documents are expected to include performance-based specifications for material placement. The actual method of placement will be at the discretion of the contractor. The method proposed for material placement at the Wyckoff/Eagle Harbor Superfund site is to wash the material off barges using water jets. At Station L, a clamshell bucket was used. Originally, the bucket was to be lowered to within 2 feet of the bottom and the material was to be released. However, it was discovered that the bucket could be lowered to just below the water surface and released, with essentially no detrimental impact to placement conditions. For a beach reconstruction project near Bremerton, Washington, dry material was moved from a barge by a conveyor.

Impacts to the river environment typically are measured by comparing turbidity readings upstream and downstream of the capping activity, with the upstream reading serving as a baseline reading. Curtailment of the operation will occur until modifications are implemented if the downstream turbidity reading exceeds the project performance standards and criteria. At Station L, the turbidity limit was an increase of 10% above the upstream reading as measured 100 feet downstream of the cap limits.

Verification of the cap thickness could be achieved through ongoing underwater surveying or settlement stakes, or a combination of the two. Placement of the materials must achieve two objectives: meet specified layer thicknesses (at a minimum) and create slopes of 2.5H:1V or less.

5.4.4 Alternatives

Alternatives for the cap must meet certain minimum requirements. The preliminary design thickness of 2 feet of sand is necessary to meet guidance requirements, and the ROD criterion that the cap must be 3 feet thick is included in the consideration of alternative cap configurations. The alternatives, therefore, are variations of the cap layers and thicknesses. A plan view of the sediment cap is shown in Drawing 3, and a cross-section through the cap is presented in Drawing 4.

The first alternative would minimize the amount of gravel and armor used throughout the cap. The gravel would be placed at all edges of the cap except at the shoreline area, extending at least 3 feet beyond the edge of the sand layer. The shoreline revetment would extend from 7 feet below the water surface, over the sand layer, and abut the regraded bank slope. Gravel placement in additional areas would be determined by using the depth-averaged velocity vs. the depth to determine the required protectiveness. In those areas where wave and river conditions do not mandate gravel or armor, an additional foot of sand will complete the 3-foot-thick cap.

The second alternative would be a uniform cap with sand, gravel, and shoreline revetment layers as described in Section 5.4.1. This alternative would eliminate the zonal layering aspect of the first alternative and logistically may be easier to place.

The cap placement at Station L posed problems for achieving a uniform layer of adequate thickness. One recommendation from the final project report was to place gravel with a large percentage of sand. Because of the differing fall velocities in the water, the material would have to be lowered close to the river bottom before being released. This sand-gravel mixture could replace those separate layers described in the above two alternatives. (CH2M Hill 1991)

Regardless of the chosen alternative, minor deposition of sandy material might occur at the capped area over time, which would soften the harder features of the armor and filter layers.

5.5 New Site Features

Sections 5.5.1 through 5.5.3 describe the physical features and institutional controls that will be introduced at the site as a result of the RA activities.

5.5.1 Cap

Portions of the cap will be visible at the shoreline during low water periods because the cap will extend to the base of the bank. The shoreline revetment will contrast with the existing and adjacent shoreline. The future impacts of this reconfigured surface are unknown, but filling the interstices with sand, gravel, or vegetation will mitigate the ecological and aesthetic aspects of the revetment.

5.5.2 Institutional Controls

USCG
United States Coast Guard

Restrictions included in the **United States Coast Guard** (USCG)'s *Notice to Mariners* that will limit the size of vessels that sail over the cap and the types of activities that occur over the cap are expected to be posted for the waterway. The *Notice to Mariners* is broadcast to all watercraft via radio and provided to all marinas. The objective of the controls will be to minimize disturbances to the cap.

5.5.3 Riparian Restoration and Revegetation

The manmade feature of the bulkhead will be removed, and the bank in the area will be returned to a more natural appearance. The shoreline bank slopes will be regraded. Other measures to restore the site to a more habitat-friendly condition will be considered during the soil cap installation portion of the RA activities.

5.6 Operation and Maintenance Procedures

The cap will be monitored on a scheduled basis and inspected after significant natural events such as a large-magnitude earthquake or a major flood event. These events could damage the cap and thus require addition of material to maintain the cap's integrity. The inspection schedule is specified in the ROD.

6 Remedial Design Deliverables

The deliverables that have been or will be prepared during the RD phase of the project are a final SQAP; a final sediment data RD summary report; final plans, specifications, and cost estimate; and a draft and final sediment cap construction quality assurance project plan.

All deliverables will be submitted in draft form, and final documents will be submitted after receipt of DEQ comments.

The results of several data collection activities, including the geotechnical subsurface analysis, the permeation modeling, and the hydraulic modeling and floodway analysis, initially will be reported separately in technical memoranda and subsequently will be incorporated into the sediment cap design. Also, the initial results are incorporated into this report.

6.1 Geotechnical Data

HWA, a subcontractor to E & E, has prepared a draft report summarizing the results of the HWA study, including descriptions of surface and subsurface conditions, a site plan showing exploration locations and other pertinent features, summary exploration logs, and laboratory test results (see Appendix A).

In the draft report, HWA addresses static and dynamic stability of submerged slopes and delineates areas of potential instability. HWA also prepared recommendations for mitigation of the stability hazard in these areas. In addition, HWA provided input regarding compatibility of proposed cap materials with existing sediments in relation to gradations and method of placement. Preliminary information from the geotechnical study was used as a basis for portions of the cap design discussion in Section 5.4.

6.2 Permeation Modeling

A technical memorandum that describes the results of the permeation modeling and provides permeation rates for various cap thickness scenarios shall be prepared by USACE. This information shall be used in preparation of the final design to meet performance goals established in the ROD. The modeling will determine minimum thickness requirements for the cap to address contaminant permeation as discussed in Section 5.4.1.

6.3 Hydraulic Modeling and Floodway Analysis

OBA (recently acquired by Parsons Brinckerhoff Quade & Douglas, Inc.), a subcontractor to E & E, is providing hydraulic engineering support for the cap design. OBA has and will continue to use the results of the bathymetric survey, along with other previously available information, to perform several activities relevant to the cap design. These activities include analysis of potential floodrise, flood-induced water velocities, and wind waves and prop-wash. The results of these activities are being provided in several draft and final hydraulics reports which address each activity and shall be used to determine appropriate cap design requirements (see Appendix B). The data that has been generated to date has been incorporated in the discussion found in Section 5.4.1.

7 Permitting Requirements

CWA
Clean Water Act

This section describes the federal, state, and local permitting requirements for the construction of the proposed sediment cap. The action requiring a permit is the placement of material in a waterway. Because of the Superfund status of the project, formal permit applications are unnecessary; however, DEQ must meet the substantive requirements of the **Clean Water Act** (CWA), Section 404(b)(1).

bulkhead + piling removal?

7.1 Federal Requirements

The federal requirements identify the lead agency and the regulatory statute that provides the agency with permitting authority.

7.1.1 United States Environmental Protection Agency and United States Army Corps of Engineers/Clean Water Act, Section 404(b)(1)

USC
United States Code

Section 404 of the CWA (33 **United States Code** [USC] 1344) requires approval before discharge of dredged or fill material into the waters of the United States. The premise of the program is that no discharge of dredged or fill material can be permitted if a practicable alternative that is less damaging to the aquatic environment exists, or if the nation's waters would be degraded significantly. The landward regulatory limit for nontidal waters (in the absence of adjacent wetlands) is the ordinary high-water mark.

USFWS
United States Fish and Wildlife Service

Because of the Superfund status of this project, a standard Section 404 permit application process through USACE is not required. However, in order to demonstrate that the substantive requirements of the CWA and other federal requirements are met, a more specialized Section 404(b)(1) evaluation will be conducted. The evaluation will be submitted to EPA for its review and consultation with other agencies, including USACE, NMFS, the **United States Fish and Wildlife Service** (USFWS), and ODFW.

A biological evaluation that will accompany the Section 404(b)(1) evaluation is being prepared and contains supporting information related to potential biological impacts.

7.1.2 United States Army Corps of Engineers/Rivers and Harbors Act, Section 10

RHA
Rivers and Harbors Act

Various sections within the **Rivers and Harbors Act** (RHA) of 1899 establish permitting requirements to prevent unauthorized obstruction or alteration of any navigable water of the United States. The most frequently exercised authority is contained in Section 10 (33 USC 403), which covers construction, excavation, or deposition of materials in, over, or under such waters, or any work that would affect the course, location, condition, or capacity of those waters. It is assumed that the permitting decision for the RHA, Section 10, would occur at the same time as the review of the documents for the CWA, Section 404.

7.1.3 United States Coast Guard/Rivers and Harbors Management Act

USCG has permitting authority over marine events that are of short duration. USCG typically is notified of in-water activities through the USACE Section 404 process. USCG will be informed regarding the cap construction schedule and proposed activities.

7.1.4 Federal Emergency Management Agency/National Flood Insurance Program

The FEMA has an Executive Order to guide the evaluation of the proposed cap with respect to loss of conveyance of the Willamette River and the subsequent impact upon the 100-year flood plain. A floodway is used by the FEMA as a tool to assist communities in flood plain management. Under this concept, the area of the 100-year flood plain is divided into floodway and floodway fringe. If a proposed channel modification affects the floodway such that the river stage is increased for the base flood condition, such a conveyance reduction would constitute a floodway encroachment. If a proposed floodway action such as construction of a sediment cap results in a floodway encroachment, then either:

a) the encroachment must be mitigated (offset) such that there is no net increase in river stage; or

b) the floodway is realigned or adjusted in consultation with the requisite authorities.

OPDR
City of Portland Office of Planning and Development Review

Within the Lower Willamette River, floodway management is administered jointly by the FEMA, the **City of Portland Office of Planning and Development Review** (OPDR), and Metro. These agencies will review the floodway encroachment analysis and participate in either the mitigation or realignment as described above.

7.1.5 United States Fish and Wildlife Service/ Endangered Species Act, Section 7, and Essential Fish Habitat

USFWS will coordinate with USACE to ensure compliance with the requirements of the ESA for terrestrial wildlife, plant, and resident fish species. USFWS will review the biological evaluation prepared as supporting information for the Section 404(b)(1) evaluation.

7.1.6 National Marine Fisheries Service/Endangered Species Act, Section 7

NMFS will coordinate with USACE to ensure compliance with the requirements of the ESA for anadromous salmonids and marine mammals. NMFS will review the biological evaluation prepared as supporting information for the Section 404(b)(1) evaluation. In addition, NMFS will be consulted on the Essential Fish Habitat as defined in the Magnuson-Stevens Fishery Conservation and Management Act (1976) as it relates to this project.

7.2 State of Oregon Requirements

Three State of Oregon agencies will have primary permitting authority for this project.

7.2.1 Oregon Department of Environmental Quality/ Clean Water Act, Section 401

Section 401 of the federal CWA requires that any applicant for a federal license or permit to conduct any activity that may result in a discharge to waters of the state must provide the licensing or permitting agency with a certification from DEQ stating that the activity complies with water quality requirements and standards. DEQ administers the Section 401 Water Quality Certification process. USACE coordinates with DEQ on water-quality-related permitting conditions. Conditions typically restrict the in-water work window established by ODFW and require minimization of turbidity and erosion in the water body.

DSL
Division of State Lands

In Oregon, projects in which the applicant will dredge, fill, or otherwise alter a waterway require a permit from the Oregon **Division of State Lands** (DSL; see Section 7.2.2) and USACE (see Section 7.1.1). The two agencies have developed a joint permit application. After DSL and USACE receive the joint permit application, they forward it to DEQ. DEQ reviews the project to ensure that it does not endanger Oregon's streams and wetlands and to confirm that the plans meet water quality laws and standards. Applicants frequently are required to incorporate protective measures, such as bank stabilization, treatment of stormwater runoff, spill protection, and fish and wildlife protection, into their construction and operational plans.

7.2.2 Oregon Division of State Lands/Oregon Removal-Fill Law

Oregon's Removal-Fill Law requires DSL to issue removal-fill permits to conserve, restore, and maintain the health of Oregon's waters. The removal-fill permit requires an application submitted to DSL and USACE. A permit is required for quantities of removal and/or fill in excess of 50 cubic yards. Mitigation for such impacts also is required; however, this project is exempt from DSL permitting requirements through the Comprehensive Environmental Response, Compensation, and Liability Act. Renewal of a submerged lands lease will not be necessary to perform the capping activities as the purpose of the project is not related to water usage.

7.2.3 Oregon Department of Fish and Wildlife/Oregon Removal-Fill Law

DSL coordinates with ODFW during the removal-fill permitting process to evaluate potential impacts on sensitive wildlife, fish, and plant species. ODFW established two in-water work windows for the Lower Willamette River: July 1 to October 31 and December 1 to January 31.

7.3 Local Requirements

7.3.1 City of Portland Office of Planning and Development Review/National Flood Insurance Program

OPDR regulates structures and property impacts for activities in the flood plain/floodway. The City administers the permitting, and engineering questions are directed to the FEMA. The City will be involved in the evaluation of the floodway encroachment analysis as described in Section 7.1.5. In other evaluations of floodway encroachment, the City required mitigation for a 0.01-foot rise in the base flood condition.

7.3.2 City of Portland Office of Planning and Development Review/Greenway Regulations

City of Portland greenway regulations are in effect along the riparian zone of the Lower Willamette River. These regulations are intended to protect, conserve, enhance, and maintain the natural, scenic, historic, economic, and recreational qualities of lands along Portland's rivers. A greenway review and Greenway Goal Exception will be necessary for the sediment capping proposal because of potential impacts in the greenway setback area. Required mitigation may include landscaping and possibly bioengineering solutions along the bank.

7.4 Permitting Approach

In order to meet the federal permitting requirements for this project, DEQ initiated preparation of a biological evaluation that contains information regarding the proposed project's potential impacts on biological habitat and certain species. This biological evaluation shall be included as supporting information for a CWA, Section 404(b)(1), evaluation that will be submitted to EPA for review of ecological impacts. As the federal action agency, EPA shall initiate the permit evaluation process, including submittal to USACE and other federal agencies. Information contained in this submittal will be reviewed by NMFS, USFWS, and ODFW to determine whether their particular jurisdictional needs are met.

In addition, documents also shall be prepared and submitted to local agencies in order to demonstrate that the substantive requirements of local jurisdictions are met. For example, a document shall be submitted to OPDR to satisfy FEMA flood plain/floodway management requirements and greenway review needs.

Additional correspondence needs that have been identified and that will be implemented include the following:

- Establishing a license agreement with the BNRR for encroaching on its right-of-way;
- Communicating with the Port of Portland for advisement regarding harbor line restrictions and the ongoing RI in the adjacent Willamette Cove; and

- Consulting with Metro for Title 3 setback requirements and the RI in Willamette Cove.

8 Contracting Strategy

This section describes features of the contracting process.

8.1 Performance-Based Specifications

The specifications will set forth performance requirements to the extent possible, with the objective of constructing a cap that meets the requirements of this project. The components of this project to be performed include:

- Demolition in and out of water;
- Regrading the upland bank and using fill in-water to lessen slopes to at least 2.5H:1V;
- Providing cap materials that will meet the specifications;
- Placing the cap materials in a manner and at a rate that will minimize resuspension of the contaminated sediments; and
- Monitoring for water quality during construction.

The details of these requirements beyond the discussion in this report will be provided in the contract documents. As long as the established standards are met, the contractor is free to use available methods and resources that provide a quality product.

8.2 Contractor Prequalification

Prequalification of the contractors will serve two purposes. It will assure DEQ that the contractors are qualified to do the work and will enable the contractor selection process to proceed simultaneously with final document preparation. A portion of the demolition work may be implemented under a separate contract.

8.3 Construction Specifications Institute Outline and Summary of Work

The Construction Specifications Institute divisions and sections that are expected to be included in the contract documents are presented in Table 8-1.

A draft of Section 01010, "Summary of Work," is in Appendix C.

Table 8-1 CSI Outline
McCormick and Baxter Creosoting Company, Portland Plant
Portland, Oregon

Division	Section	Title
0	00020	Invitation to Bid
0	00100	Instructions to Bidders
0	00300	Bid Form
0	00400	Supplements to Bid Form
0	00500	Agreement Form
0	00600	Bonds
0	00700	General Conditions
0	00800	Special Conditions
0	00801	Commencement, Prosecution, and Completion of Work
0	00802	Insurance
0	00880	Wage Rates
0	00890	Previous Studies
1	01005	List of Abbreviations
1	01010	Summary of Work
1	01140	Work Restrictions
1	01210	Preconstruction and Project Meetings
1	01300	Submittals
1	01430	Construction Operations Plan
1	01440	Workmanship
1	01450	Contractor Safety and Health Plan
1	01520	Field Office
1	01600	Site Survey
1	01650	Protection of the Environment
1	01700	Contract Documentation and Closeout
1	01800	Measurement and Payment
2	02050	Demolition
2	02310	Sediment Cap
2	02940	Off-Site Transportation of Wastes
2	02950	Off-Site Disposal of Wastes

Key:

CSI = Construction Specifications Institute.

9 Construction Schedule and Cost Estimate

The construction schedule is provided in Appendix D. The schedule was developed to meet the ODFW construction window for in-water work for the Lower Willamette River.

Table 9-1 presents the preliminary construction cost estimate. R.S. Means Co., Inc., cost estimating references and discussions with vendors were used as sources to establish the costs.

Table 9-1 Sediment Cap Preliminary Cost Estimate
McCormick and Baxter Creosoting Company, Portland Plant
Portland, Oregon

Description	Unit	Unit Cost	Quantity	Total Cost
Bulkhead removal (as separate contract)	lump sum	$87,000	1	$87,000
Mobilization/demobilization	lump sum	$100,000	1	$100,000
Monitoring well demolition	each	$2,000	11	$22,000
Piling/dolphin removal[1]	each	$100	550/160	$71,000
Sand cap component[2]	cy	$15	55,000	$825,000
Gravel cap component	cy	$20	27,500	$550,000
Shoreline revetment[3]	sf	~$3	320,000	$1,000,000
Survey	lump sum	$10,000	2	$20,000
Construction subtotal[4]				$2,588,000
Administration[4], 15%				$388,000
Contingency[4], 45%				$1,165,000
TOTAL[5]				**$4,228,000**

Sources: R.S. Means Co., Inc., 1999, 2000 Site Work & Landscape Cost Data, 19th Annual Edition.
Greg Speyer, Hickey Marine, telephone conversation with Susan Gardner, E&E, 12/15/00.

[1] Assumes pilings will be recycled.
[2] Assumes dredged Columbia River material through contractor.
[3] Cost reportedly comparable to riprap.
[4] Bulkhead removal not included.
[5] Includes bulkhead cost.

Key:

cy = Cubic yard.
sf = Square feet.

10 References

AquaResources, Inc., 1983, *Summary of Soil and Groundwater Quality Data—Portland Plant*, Berkeley, California.

CH2M Hill, 1991, *Final Report, Phase II, Station L PCB-Contaminated River Sediment Remediation*, submitted to Portland General Electric, Portland, Oregon.

———, 1987, *McCormick & Baxter Creosoting Co. Portland Plant: Environmental Contamination Site Assessment and Remedial Action Report, Volume 1*, submitted to Oregon Department of Environmental Quality (DEQ), Portland, Oregon, prepared by McCormick & Baxter Creosoting Company and CH2M Hill, Portland, Oregon.

———, 1985, *McCormick & Baxter Creosoting Company Site Water and Soil Investigation, Interim Report*, submitted to DEQ, Portland, Oregon.

Diener, D., and D. Moore, February 2001, MEC Analytical Systems, Inc., telephone conversation with Heather Brunelle, Ecology and Environment, Inc., Portland, Oregon.

Ecology and Environment, Inc., February 2001, *Draft Sediment Remedial Design Data Summary Report, McCormick & Baxter Creosoting Company*, Portland, Oregon.

———, December 4, 2000, *Final Sediment Remedial Design Sampling and Quality Assurance Plan Amendment for the McCormick & Baxter Creosoting Company*, submitted to DEQ, Portland, Oregon.

———, October 1999a, *Sediment Remedial Design Sampling Data Summary Report, McCormick & Baxter Creosoting Company*, submitted to Oregon Department of Environmental Quality (DEQ), Portland, Oregon.

———, August 1999b, *Final Sediment Remedial Design Sampling and Quality Assurance Plan, McCormick & Baxter Creosoting Company*, submitted to DEQ, Portland, Oregon.

———, 1994, *Quality Assurance Program Plan for Alternative Remedial Contracting Strategy (ARCS West), EPA Regions 9 and 10*, prepared for United States Environmental Protection Agency (EPA), Region 10, Seattle, Washington.

———, 1993, *Site Inspection, McCormick & Baxter Creosoting Company*, prepared for EPA, Region 10, Seattle, Washington.

———, 1983, *Site Inspection, McCormick & Baxter Creosoting Company*, prepared for EPA, Region 10, Seattle, Washington.

HWA Geosciences, Inc., December 8, 2000a, *Preliminary Geotechnical Report, McCormick & Baxter Sediment Cap Project, Willamette River, Portland, Oregon.*

———, August 28, 2000b, memorandum from Andre Mare regarding *Preliminary Findings, Geotechnical Issues, McCormick & Baxter Sediment Cap Project,* to Peter Geiger, Ecology and Environment, Inc., Portland, Oregon.

Ogden Beeman and Associates, February 8, 2001, *Preliminary 2-D Hydraulic Model Results* for the Federal Emergency Management Act (FEMA) 0.2% flood, map indicating depth-averaged velocity.

———, December 8, 2000a, memorandum from Jerald Ramsden regarding *Sediment Cap 30% Design, Hydraulic Parameters,* to Susan Gardner, Ecology and Environment, Inc., Seattle, Washington.

———, October 10, 2000b, *Preliminary 2-D Hydraulic Model Results* for the FEMA 1% flood, map indicating depth-averaged velocity.

———, March 27, 2000c, *Comparison of Willamette River Hydrographic Surveys, McCormick and Baxter Creosoting Company, Portland, Oregon.*

Oregon Department of Environmental Quality, 1999, *Portland Harbor Sediment Management Plan*, Portland, Oregon.

Palermo, M., S. Maynord, J. Miler, and D. Reible, 1998, *EPA's Assessment and Remediation of Contaminated Sediments (ARCS) Program: Guidance for In-Situ Subaqueous*

Capping of Contaminated Sediments, United States Environmental Protection Agency 905-B96-004, Great Lakes National Program Office, Chicago, Illinois.

PTI Environmental Services, 1995, *Revised Feasibility Study, McCormick & Baxter Creosoting Company*, prepared for Oregon Department of Environmental Quality (DEQ), Portland, Oregon, Lake Oswego, Oregon.

———, 1992a, *McCormick & Baxter Creosoting Company Remedial Investigation Report*, prepared for DEQ, Portland, Oregon, Bellevue, Washington.

———, 1992b, *McCormick & Baxter Feasibility Study Report*, prepared for DEQ, Portland, Oregon, Lake Oswego, Oregon.

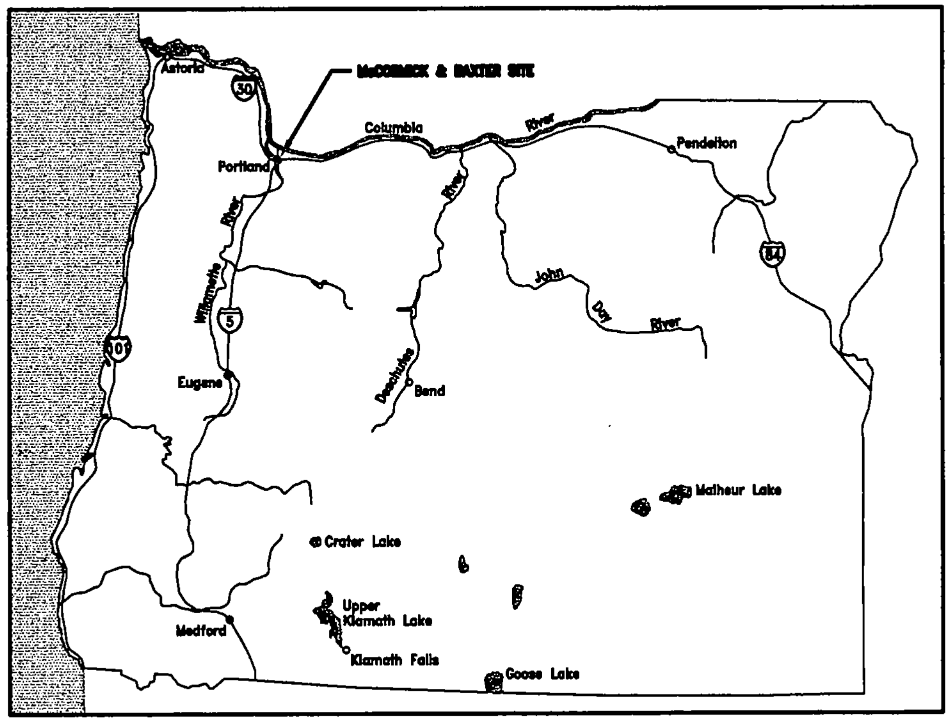
United States Army Corps of Engineers (USACE), August 29, 2000, *Data Needs Report letter to Mr. William H. Dana, DEQ, from Miriam Ramsey, Project Manager.*

———, June 1998, *Guidance for Subaqueous Dredged Material Capping,* Technical Report DOER-1, by M.R. Palermo et al.

United States Environmental Protection Agency (EPA), March 1996, *Record of Decision (ROD), McCormick & Baxter Creosoting Company, Portland Plant, Portland, Oregon.*

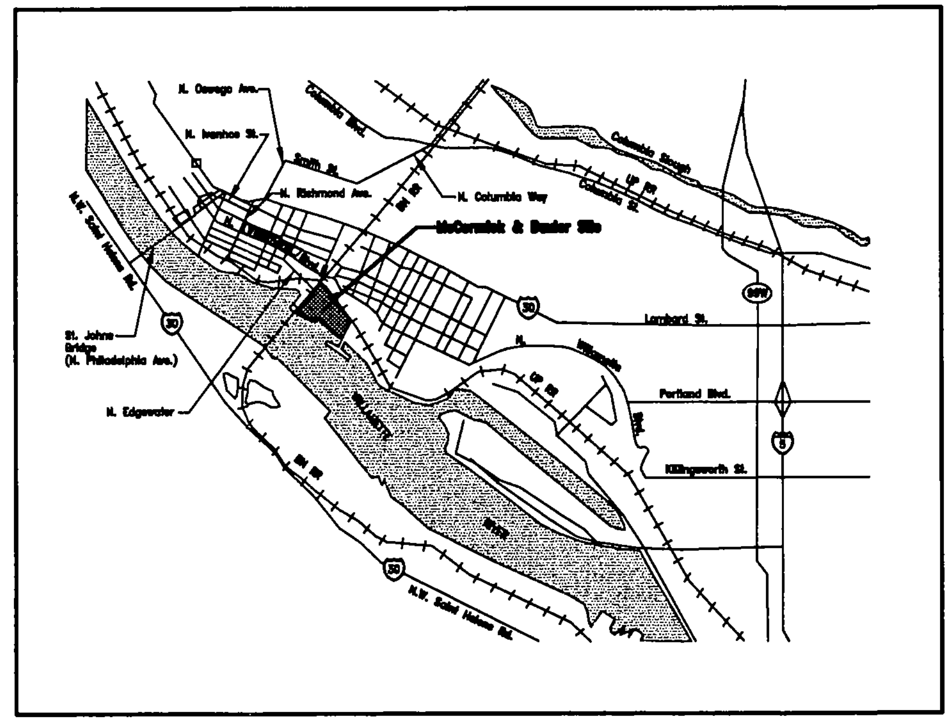
749.0A01.00.11.01/0A01S01E.DWG/S.GARDNER-ENG'R/B.MORRIS-AUTOCAD/12-15-00/SEATTLE,WA.

McCORMICK AND BAXTER CREOSOTING CO. SITE
PORTLAND PLANT
Portland, Oregon
SEDIMENT CAP



VICINITY MAP

INDEX OF DRAWINGS	
DRAWING NUMBER	SHEET TITLE
1 OF 4	TITLE SHEET
2 OF 4	SURFACE & SUBSURFACE DEMOLITION PLAN
3 OF 4	SEDIMENT CAP PLAN
4 OF 4	SEDIMENT CAP CROSS-SECTION



SITE LOCATION MAP

Prepared for:

OREGON DEPARTMENT
OF
ENVIRONMENTAL QUALITY
SITE RESPONSE SECTION

811 SW Sixth Ave.
Portland, Oregon 97204

by:

Ecology and Environment, Inc.
333 SW Fifth Ave.
Portland, Oregon 97204

NO.	DATE	DWN	APP'D	DESCRIPTION
REVISIONS				

ecology and environment, inc.
International Specialists in the Environment
Seattle, Washington

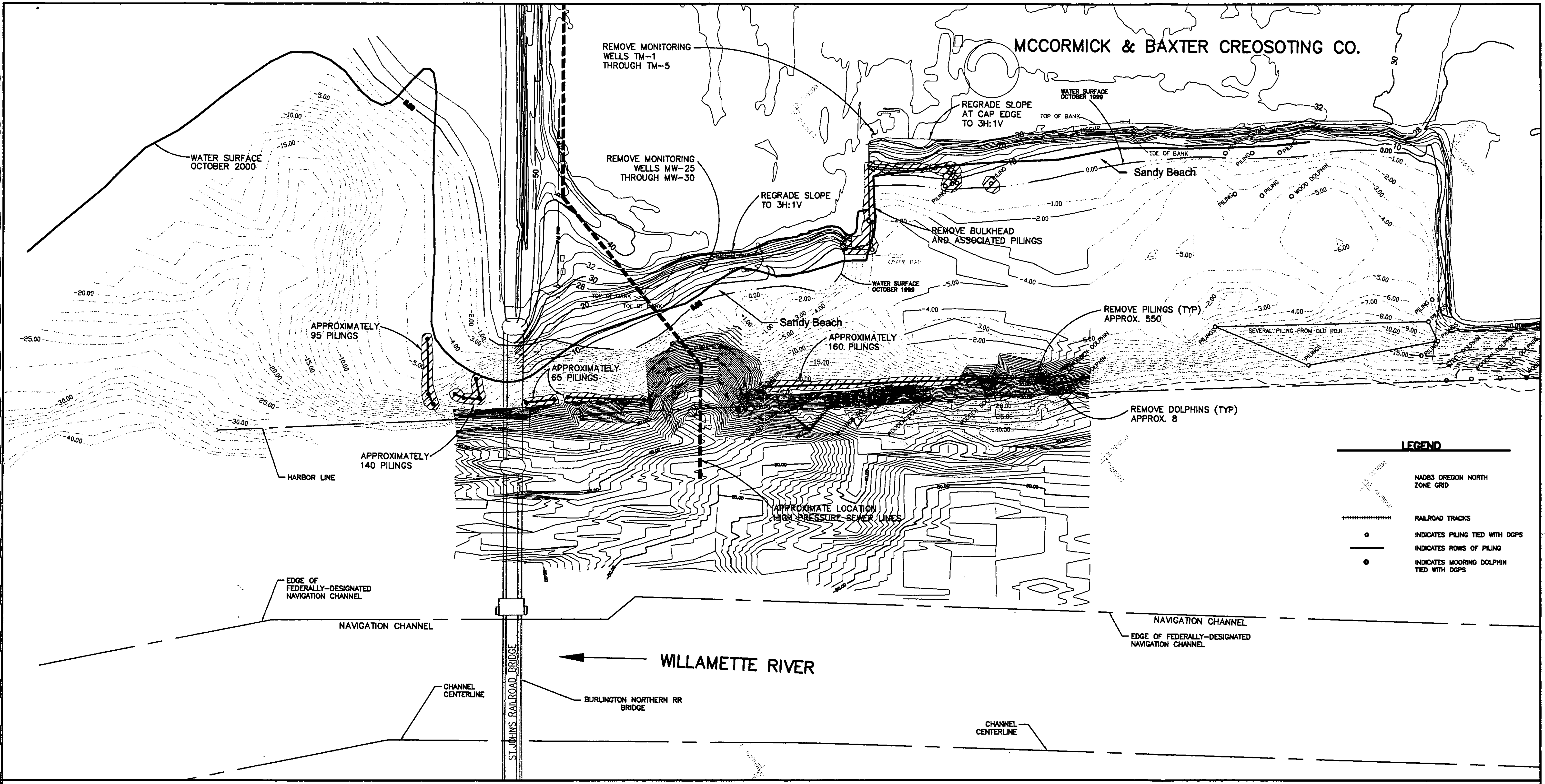
DESIGNED BY: C. NANCARROW
CHECKED BY: S. GARDNER
DRAWN BY: B. MORRIS
APPROVED BY: A. WHITMAN

TITLE SHEET
McCORMICK AND BAXTER CREOSOTING COMPANY SITE PORTLAND PLANT
PORTLAND, OREGON

SCALE	DATE ISSUED	C.A.D. FILE NO.	DRAWING NO.
NONE	12-15-00	0A01S01E.DWG	1 OF 4

SEA PLOTTED: 02-14-01 BEM

I:\FROMNT\749.0A01.00.11.01\0A01S02E.DWG\S.GARDNER-ENG'R\B.MORRIS-AUTOCAD\02-13-01\SEATTLE,WA



NOTES (FOR SCREENED-BACK BATHYMETRIC CONTOURS):

This drawing represents a bathymetric survey conducted by David Evans and Associates, Inc..

Date of survey: October 21, 1999.

Horizontal positions were acquired with a combined Inertial and Differential Global Positioning System (DGPS).

Horizontal Datum: North American Datum of 1983 (NAD83), State Plane Coordinate System (SPCS), Oregon North Zone (International Feet).

Vertical Datum: Columbia River Datum (CRD). Units are in feet.

Gauge Location: Gauge located at the Gunderson pier.

Multibeam depths were acquired with a Reson Seabat 8101 Bathymetric Sonar System. Integrated in Triton Isis with a TSS POS M/V positioning and motion reference sensor. Single Beam depths were acquired with an Innerspace 448 Echosounder.

A sound velocity profile was conducted periodically during the survey with a SEACAT SBE 19 CTD.

NOTES (FOR DARKER BATHYMETRIC CONTOURS):

- Bathymetric contouring by Minister-Glaeser Surveying, Inc. (MGS)

1. Horizontal Datum: Oregon State Plane Coordinate System, North Zone (NAD-83), Intl. Feet.
2. Soundings are shown in feet and indicate elevations in reference to Columbia River Datum (CRD).
3. Horizontal positions for Navigation and Data collection were determined by using a Trimble 4000 SSE G.P.S. System operating in a Differential Mode, Using the G.P.S. continuously operating Reference Station (CORS) at Appleton, Washington.
4. Bathymetric Data was collected using an Innerspace 448 Echosounder with an 8" Single Beam Transducer.
5. Survey Data was collected perpendicular with the shore line using a one-hundred foot line spacing. The survey data collected along each survey line was thinned using a "Shoal-Basis" Method to an approximate horizontal spacing of ten feet.
6. There may be Bottom Features that are not shown on this map because of the Line Spacing Interval. This Survey does not include Bathymetric Data between the adjacent survey lines.
7. This Bathymetric Survey is representative of the condition of the condition of the Slough Bottom at the time of the survey based on the Line Spacing Interval and Thinning method used. The condition of the Slough Bottom may change at any time after the date of this survey.
8. Water Surface Elevation at the time of this Survey ranged between 1.5 and 2.3 feet.
9. Data collected: October 25, 2000.
10. Railroad Bridge and Shoreline Linework is shown for graphical purpose only. Linework was supplied by Ecology & Environment, Inc. and was not verified during this survey. Bridge Piers were located with DGPS during this survey. The accuracy of these positions are not likely to be of Sub-Meter Accuracy due to overhead Interference degrading GPS Signals.
11. All Shallow Water Data shown between the old dock site and the shore was provided by E&E, Inc. MGS makes no guarentees as to the accuracy of this data.

ADDITIONAL NOTES:

1. Navigation Channel and Harbor Line taken from USACE, Portland District, Construction-Operations Division Drawing Number WR-4-98 (20 March, 2000).
2. Upland Topography appears to be referenced to the National Geodetic Vertical Datum (NGVD) 1929. The CRD used in the Bathymetric Surveys is approximately 1.74 feet above the NGVD.

ecology and environment, inc.
International Specialists in the Environment
Seattle, Washington

DESIGNED BY: J. MONTGOMERY
CHECKED BY: P. GEIGER
DRAWN BY: B. MORRIS
APPROVED BY XXXXXXX

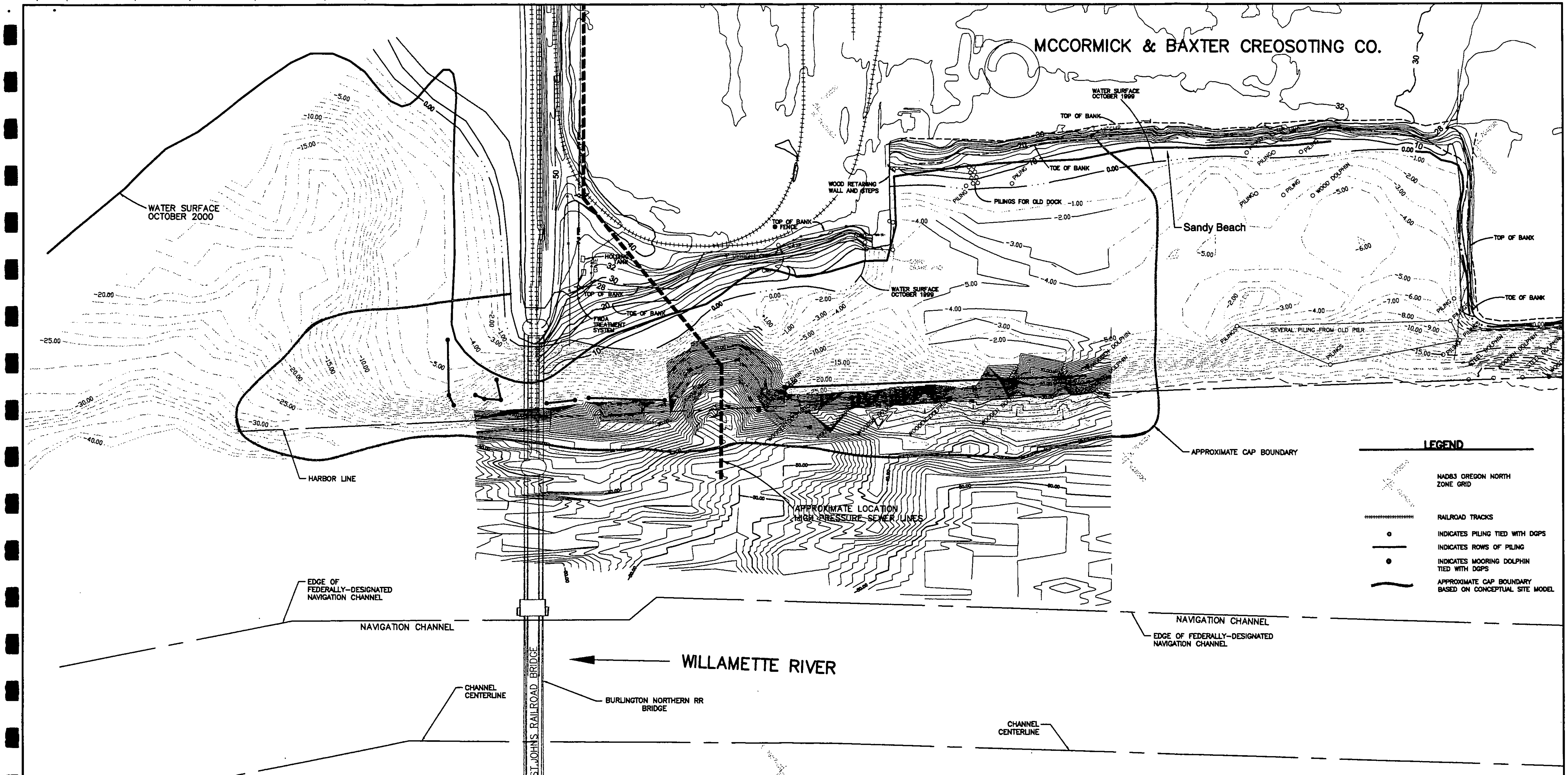
SURFACE & SUBSURFACE DEMOLITION PLAN

Mc CORMICK & BAXTER CREOSOTING CO. PORTLAND, OREGON

SCALE	DATE ISSUED	CAD FILE NO.	DRAWING NO.
NOTED	02-13-01	0A01S02E.DWG	2 of 4

PLOTTED: 4-01

I:\FROMNT\749.0A01.00.11.01\OA01S03E.DWG\S.GARDNER-ENG'R\B.MORRIS-AUTOCAD\02-14-01\SEATTLE,WA



NOTES (FOR SCREENED-BACK BATHYMETRIC CONTOURS):

This drawing represents a bathymetric survey conducted by David Evans and Associates, Inc..

Date of survey: October 21, 1999.

Horizontal positions were acquired with a combined Inertial and Differential Global Positioning System (DGPS).

Horizontal Datum: North American Datum of 1983 (NAD83), State Plane Coordinate System (SPCS), Oregon North Zone (International Feet).

Vertical Datum: Columbia River Datum (CRD). Units are in feet.

Gauge Location: Gauge located at the Gunderson pier.

Multibeam depths were acquired with a Reson Seabat 8101 Bathymetric Sonar System. Integrated in Triton Isis with a TSS POS M/V positioning and motion reference sensor. Single Beam depths were acquired with an Innerspace 448 Echosounder.

A sound velocity profile was conducted periodically during the survey with a SEACAT SBE 19 CTD.

NOTES (FOR DARKER BATHYMETRIC CONTOURS):

- Bathymetric contouring by Minister-Glaeser Surveying, Inc. (MGS)

1. Horizontal Datum: Oregon State Plane Coordinate System, North Zone (NAD-83), Intl. Feet.
2. Soundings are shown in feet and indicate elevations in reference to Columbia River Datum (CRD).
3. Horizontal positions for Navigation and Data collection were determined by using a Trimble 4000 SSE G.P.S. System operating in a Differential Mode, Using the G.P.S. continuously operating Reference Station (CORS) at Appleton, Washington.
4. Bathymetric Data was collected using an Innerspace 448 Echosounder with an 8" Single Beam Transducer.
5. Survey Data was collected perpendicular with the shore line using a one-hundred foot line spacing. The survey data collected along each survey line was thinned using a "Shoal-Basis" Method to an approximate horizontal spacing of ten feet.
6. There may be Bottom Features that are not shown on this map because of the Line Spacing Interval. This Survey does not include Bathymetric Data between the adjacent survey lines.
7. This Bathymetric Survey is representative of the condition of the condition of the Slough Bottom at the time of the survey based on the Line Spacing Interval and Thinning method used. The condition of the Slough Bottom may change at any time after the date of this survey.
8. Water Surface Elevation at the time of this Survey ranged between 1.5 and 2.3 feet.
9. Data collected: October 25, 2000.
10. Railroad Bridge and Shoreline Linework is shown for graphical purpose only. Linework was supplied by Ecology & Environment, Inc. and was not verified during this survey. Bridge Piers were located with DGPS during this survey. The accuracy of these positions are not likely to be of Sub-Meter Accuracy due to overhead interference degrading GPS Signals.
11. All Shallow Water Data shown between the old dock site and the shore was provided by E&E, Inc. MGS makes no guarentees as to the accuracy of this data.

ADDITIONAL NOTES:

1. Navigation Channel and Harbor Line taken from USACE, Portland District, Construction-Operations Division Drawing Number WR-4-98 (20 March, 2000).
2. Upland Topography appears to be referenced to the National Geodetic Vertical Datum (NGVD) 1929. The CRD used in the Bathymetric Surveys is approximately 1.74 feet above the NGVD.

SCALE IN FEET
0 100 200 300

ecology and environment, inc.
International Specialists in the Environment
Seattle, Washington

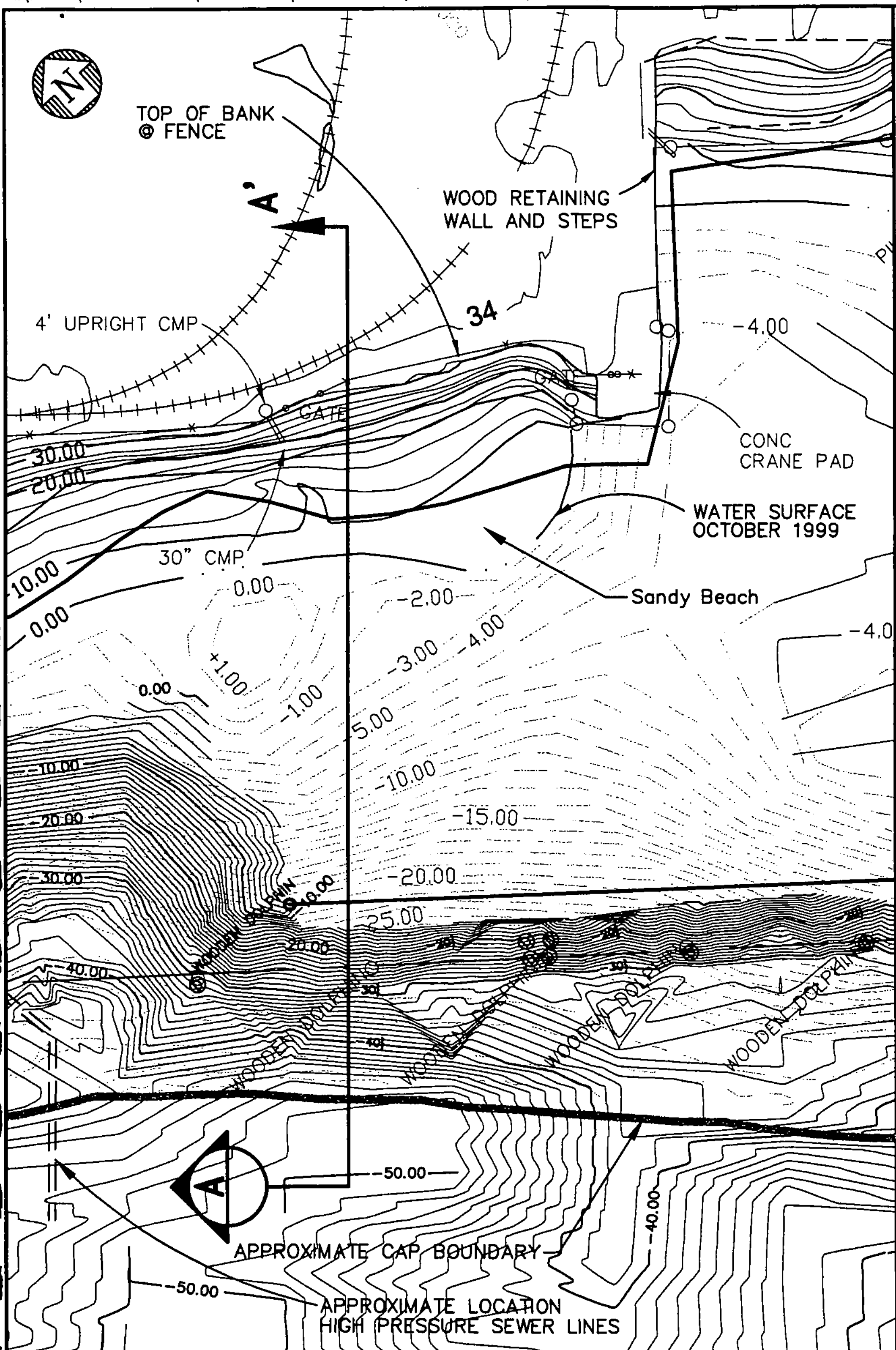
DESIGNED BY: J. MONTGOMERY
CHECKED BY: P. GEIGER
DRAWN BY: B. MORRIS
APPROVED BY XXXXXXX

SEDIMENT CAP PLAN

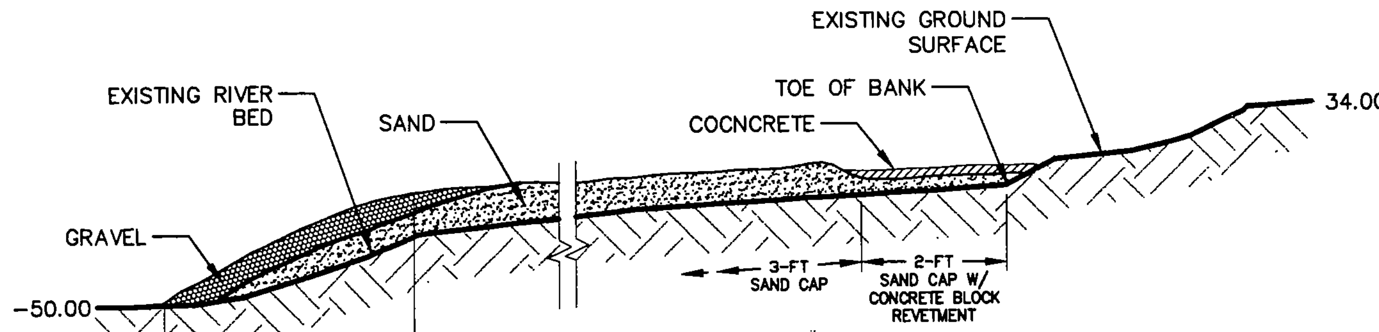
Mc CORMICK & BAXTER CREOSOTING CO. PORTLAND, OREGON

SCALE	DATE ISSUED	CAD FILE NO.	DRAWING NO.
NOTED	02-14-01	OA01S03E.DWG	3 of 4

PLOTTED 14-01

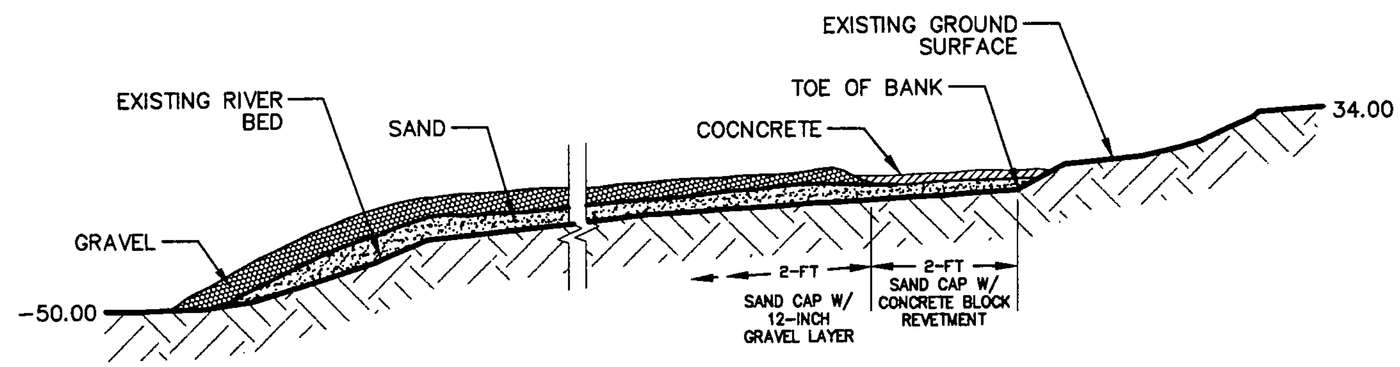


PLAN
SEDIMENT CAP
SCALE IN FEET
0 50 100 150



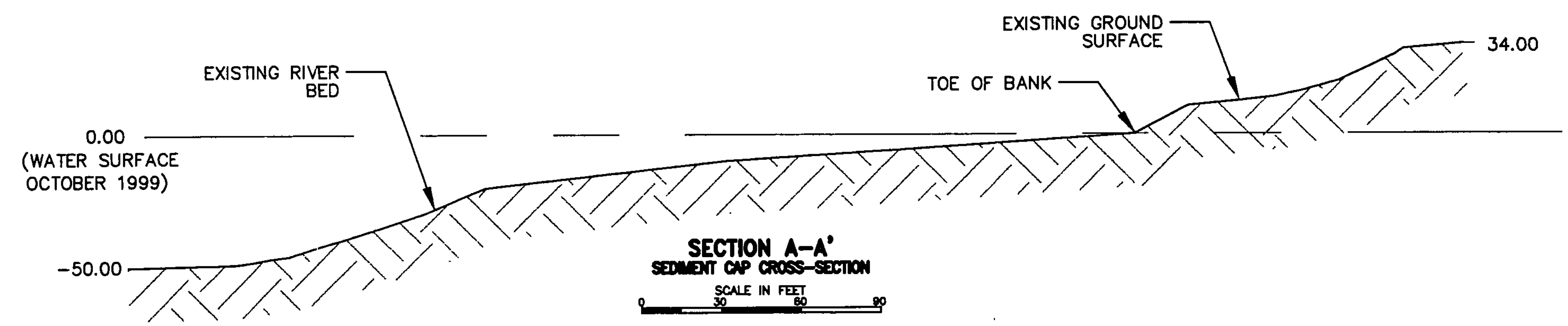
CROSS SECTION
ALTERNATIVE 1
SEDIMENT CAP
NOT TO SCALE

NOTES:
1. 12-INCH GRAVEL LAYER AT CAP EDGES, ON STEEP SLOPES, AND AT AREAS OF HIGH VELOCITY.
2. FLATTEN STEEP SLOPES TO AT LEAST 2.5H:1V WITH SAND AND GRAVEL FILL.
3. FINAL CAP COMPONENT THICKNESS TO BE DETERMINED BY PENDING ANALYSES AND MODELING.



CROSS SECTION
ALTERNATIVE 2
SEDIMENT CAP
NOT TO SCALE

NOTES:
1. FLATTEN STEEP SLOPES TO AT LEAST 2.5H:1V WITH SAND AND GRAVEL FILL.
2. FINAL CAP COMPONENT THICKNESS TO BE DETERMINED BY PENDING ANALYSES AND MODELING.



SECTION A-A'
SEDIMENT CAP CROSS-SECTION
SCALE IN FEET
0 30 60 90

NOTES (FOR SCREENED-BACK BATHYMETRIC CONTOURS):

This drawing represents a bathymetric survey conducted by David Evans and Associates, Inc..

Date of survey: October 21, 1999.

Horizontal positions were acquired with a combined Inertial and Differential Global Positioning System (DGPS).

Horizontal Datum: North American Datum of 1983 (NAD83), State Plane Coordinate System (SPCS), Oregon North Zone (International Feet).

Vertical Datum: Columbia River Datum (CRD). Units are in feet.

Gauge Location: Gauge located at the Gunderson pier.

Multibeam depths were acquired with a Reson Seabat 8101 Bathymetric Sonar System. integrated in Triton Isis with a TSS POS M/V positioning and motion reference sensor. Single Beam depths were acquired with an Innerspace 448 Echosounder.

A sound velocity profile was conducted periodically during the survey with a SEACAT SBE 19 CTD.

NOTES (FOR DARKER BATHYMETRIC CONTOURS):

- Bathymetric contouring by Minister-Glaeser Surveying, Inc. (MGS)

1. Horizontal Datum: Oregon State Plane Coordinate System, North Zone (NAD-83), Intl. Feet.
2. Soundings are shown in feet and indicate elevations in reference to Columbia River Datum (CRD).
3. Horizontal positions for Navigation and Data collection were determined by using a Trimble 4000 SSE G.P.S. System operating in a Differential Mode, Using the G.P.S. continuously operating Reference Station (CORS) at Appleton, Washington.
4. Bathymetric Data was collected using an Innerspace 448 Echosounder with an 8" Single Beam Transducer.
5. Survey Data was collected perpendicular with the shore line using a one-hundred foot line spacing. The survey data collected along each survey line was thinned using a "Shoal-Basis" Method to an approximate horizontal spacing of ten feet.
6. There may be Bottom Features that are not shown on this map because of the Line Spacing Interval. This Survey does not include Bathymetric Data between the adjacent survey lines.
7. This Bathymetric Survey is representative of the condition of the condition of the Slough Bottom at the time of the survey based on the Line Spacing Interval and Thinning method used. The condition of the Slough Bottom may change at any time after the date of this survey.
8. Water Surface Elevation at the time of this Survey ranged between 1.5 and 2.3 feet.
9. Data collected: October 25, 2000.
10. Railroad Bridge and Shoreline Linework is shown for graphical purpose only. Linework was supplied by Ecology & Environment, Inc. and was not verified during this survey. Bridge Piers were located with DGPS during this survey. The accuracy of these positions are not likely to be of Sub-Meter Accuracy due to overhead interference degrading GPS Signals.
11. All Shallow Water Data shown between the old dock site and the shore was provided by E&E, Inc. MGS makes no guarentees as to the accuracy of this data.

ADDITIONAL NOTES:

1. Navigation Channel and Harbor Line taken from USACE, Portland District, Construction-Operations Division Drawing Number WR-4-98 (20 March, 2000).
2. Upland Topography appears to be referenced to the National Geodetic Vertical Datum (NGVD) 1929. The CRD used in the Bathymetric Surveys is approximately 1.74 feet above the NGVD.

LEGEND

NAD83 OREGON NORTH ZONE GRID

RAILROAD TRACKS

INDICATES PILING TIED WITH DGPS

INDICATES ROWS OF PILING

INDICATES MOORING DOLPHIN TIED WITH DGPS

APPROXIMATE CAP BOUNDARY BASED ON CONCEPTUAL SITE MODEL

ecology and environment, inc.
International Specialists in the Environment
Seattle,Washington

DESIGNED BY: J. MONTGOMERY
CHECKED BY: P. GEIGER
DRAWN BY: B. MORRIS
APPROVED BY XXXXXXX

SEDIMENT CAP CROSS-SECTION

Mc CORMICK & BAXTER CREOSOTING CO. PORTLAND, OREGON

SCALE	DATE ISSUED	CAD FILE NO.	DRAWING NO.
NOTED	02-15-01	0A01S04E.DWG	4 of 4

Note: This page is intentionally left blank.

A

Preliminary Geotechnical Analyses

HWA
HWA GEOSCIENCES INC.
5895 JEAN ROAD
LAKE OSWEGO, OR 97035-5303
TEL. 503-675-5282
FAX. 503-675-2807

December 8, 2000
HWA Project No. 2000-115

Ecology and Environment, Inc.
333 SW Fifth Avenue, Suite 609
Portland, Oregon 97204

Attention: Mr. John Montgomery

Subject: **Preliminary Geotechnical Report**
McCormick & Baxter Sediment Cap Project
Willamette River
Portland, Oregon

Dear John:

Enclosed herein are HWA's preliminary findings from our recent exploratory work within the Willamette River offshore of the McCormick & Baxter site in north Portland, Oregon. Our geotechnical study is ongoing and geotechnical laboratory testing is partially complete. This letter presents our findings and preliminary recommendations related to the geotechnical aspects of the project for your use in preparation of the 30 percent design documents.

BACKGROUND

Ecology and Environment, Inc. (E&E) is providing the Oregon Department of Environmental Quality with design services for an offshore sediment cap to isolate contaminated sediments along the Willamette River bottom. We understand the source of material for the 3- to 4-foot-thick cap has not been determined but will most likely be dredged sands from the Columbia River channel, which typically consist of fine sands. The method of placement also has not been determined but hydraulic placement from barges has been suggested.

Figure 1 shows the offshore portion of the McCormick & Baxter site and includes river bottom contours interpreted by HWA from a recent (October, 2000) bathymetric survey. The current lateral limits of the proposed sediment cap extend from the shoreline to approximately elevation -40 feet and from approximately the right edge of Figure 1 to about 200 feet beyond the left edge. We understand the preliminary cap design for the majority of this area consists of 2 feet of sand overlain by a 12-inch filter layer consisting of predominantly gravel, which in turn will be overlain by a 12-inch rip-rap armouring layer.

HWA has been retained by E&E to perform geotechnical engineering studies and provide design and construction recommendations related to geotechnical aspects of the project. Chief among geotechnical concerns are the during- and post-construction stability of offshore slopes.

FIELD EXPLORATION

Field explorations for the project included drilling 3 soil borings (BH-1 through BH-3) from a truck mounted drill rig on a barge. The approximate locations of these explorations are indicated on the Site and Exploration Plan, Figure 1. The explorations were located in the field using a portable Global Positioning System (GPS) device calibrated to State Plane Coordinates. River bottom elevations determined in the field were consistent with bottom elevations predicted based on the recent bathymetric survey.

Borings were drilled on November 2 and 3, 2000 under the direction of HWA personnel, who also compiled logs of the borings and delivered soil samples to the HWA laboratory in Lynnwood, Washington. The depth of each boring was 26½ feet below mudline. Geotechnical drilling was performed by Subsurface Technologies Inc. of Banks, Oregon under subcontract to HWA. The borings were drilled using mud rotary methods and a Mobile B-57 drill rig. Upon completion of drilling, the borings were backfilled with bentonite chips.

Previous explorations were performed on- and off-shore at the site primarily relating to the assessment of contamination levels. Locations of selected pre-existing borings are also shown on Figure 1, and logs and lab sheets are attached as Appendix C.

LABORATORY TESTING

Samples collected in the field were delivered to our laboratory in Lynnwood, Washington for further examination and testing. Selected soil samples are currently being tested in accordance with ASTM (American Society for Testing and Materials) methods for natural moisture content, grain size distribution, and triaxial undrained shear testing. The available laboratory test results are presented in Appendix B. Certain test results are displayed where appropriate on the summary logs in Appendix A.

SITE CONDITIONS

As shown on Figure 1, a relatively steep bank, characterized by slope inclinations exceeding 3H:1V (horizontal : vertical) extends from approximate elevation 0 feet to -30 feet. Slope inclinations in this zone, which is outlined on Figure 1, generally average about 2.5H:1V and are as steep as 2H:1V in limited areas. Below elevation -30 feet, slope inclinations decrease rapidly to about 8H:1V or flatter.

Near surface soils encountered offshore during this study and previous studies indicate the site is underlain generally by dark gray, poorly graded, fine to medium grained, clean to slightly silty SAND. Some samples contained small proportions of coarse sand and fine gravel. Near-surface sands were generally loose to medium dense, although a dense sand layer was encountered in boring BH-1 between about 7 and 12 feet deep. Occasional wood fragments were encountered in HWA borings and previous borings to depths of 70 feet. Previous explorations indicate the sands extend to about elevation -90 feet or deeper. Lateral variation across the site is minimal.

Water levels in the river generally vary between about elevation 0 feet in the summer and 10 feet in the winter. The 100-year flood is reportedly elevation 28.5 feet.

Laboratory triaxial shear testing results are incomplete, but preliminary indications are that the native sands appear to possess relatively high strength considering their loose condition. This observation is supported by noting that subaqueous slopes exist at inclinations of 2H:1V, or approximately 27 degrees.

CONCLUSIONS AND RECOMMENDATIONS

In preparation of our exploration program, performance of geotechnical engineering analyses, and preparation of design and construction recommendations, we have referenced available guidance documents and recent case studies. The project *Data Needs Report* (Corps, 2000a) states that under the Federal Clean Water Act, the project cap design should be guided by two documents, *Guidance for In-Situ Subaqueous Capping of Contaminated Sediments* (U.S. EPA, 1998) and *Guidance for Subaqueous Dredged Material Capping* (Palermo et al., 1998). HWA has followed the guidance of these documents to the extent practical. Note, however, that the McCormick & Baxter site differs from the large majority of previous capping projects in that contaminated sediments are non-cohesive. The guidance documents are clearly written from the assumption of cohesive sediments. Thus, recommended test procedures such as consolidation, vane shear, and Atterberg Limits are inappropriate for this study. Similarly, the stated concerns with bearing capacity and consolidation settlement are not at issue as they would be with a more isolated cap placed over cohesive sediments.

Geotechnical design concerns include long-term slope stability, seismic concerns, and construction issues relating to successful placement of liquefied dredge sands over relatively steep slopes. These issues are addressed in the following sections. Erosion is being addressed by others.

HWA's approach to seismic issues for the project, in accordance with our agreement with E&E, follows the Corps guidance as stated in their "Data Needs Report", "*Seismic studies are not clearly identified at this time as a data need. According to Mike Palermo* *of the Waterways Experiment Station, seismic influences on caps should be considered, but often, existing information is sufficient for a qualitative evaluation of effects of seismicity on the operation and maintenance of a cap.*" (Corps, 2000a). HWA has addressed seismic issues herein in a relatively abbreviated manner. We have not performed site specific seismic response analyses nor have we performed earthquake-induced slope deformation analyses.

Slope Stability

This section addresses long-term stability of slopes. It is recognized that during placement of dredge sands, soils will be in a liquefied, low strength condition and, depending on the method of placement, may tend to spread and form flatter slopes than their post-construction shear strength would dictate. Stability during construction will be addressed later in this report.

<u>Analyses</u>

HWA performed two-dimensional static limit equilibrium analyses on proposed slopes of varying inclinations. Material property input for the analyses were based on the results of the borings and preliminary laboratory test results on the native sands. One undrained triaxial shear test performed on a sand, placed in its loosest possible state, resulted in a drained angle of internal friction (ϕ) of 33.4 degrees. Additional testing may result in lower strength; so, for our current analyses we conservatively assumed $\phi = 31$ degrees and cohesion (c) = 0.

HWA also performed two-dimensional pseudo-static limit equilibrium analyses on proposed slopes of varying inclinations. We assumed a 500-year recurrence interval earthquake with a peak horizontal ground surface acceleration of 0.20g, equivalent to the anticipated maximum horizontal bedrock acceleration for the area (Geomatrix, 1995). In accordance with common practice, we assumed a pseudo-static earthquake coefficient of 1/3 of the peak horizontal ground acceleration, or 0.07g.

Results of static and pseudo-static stability analyses indicate that slopes will be stable at an inclination 2.5H:1V or flatter. This assumes the imported cap materials will possess equivalent or greater strength than the existing sands. Results of our analyses are summarized below on Table 1.

Table 1
Summary of Slope Stability Analyses

Slope Inclination	Factor of Safety	
	Static	Pseudo-Static
2H:1V	1.20	1.11
2.5H:1V	1.50	1.25
3H:1V	1.80	1.45

Assumed Design Factor of Safety = 1.5 - static and 1.2 - pseudo-static

Recommendations

Due to the relatively high strength of the in-situ materials, it appears the long-term stability of slopes will be controlled by the strength of the imported cap materials rather than existing soils. Due to the potentially high costs of flattening or buttressing slopes, we recommend using import materials with similar strength characteristics as the existing sands. Materials considered for use as import should undergo triaxial shear testing to verify their ability to maintain the design slopes.

We recommend all slopes within the cap boundary be flattened to 2.5H:1V by placing additional fill on the slopes during capping. This may require as much as 2 feet of additional cap thickness in isolated areas, as shown schematically on the profile, Figure 2. This assumes appropriate cap material can be located as discussed above.

Slope Stability During Construction

The ability of the cap material to remain stable during placement is a function of the material type and placement technique. More specifically, the rate at which the placed materials dissipate excess pore pressures determiries the rate at which full post-construction shear strength is achieved. The capping material must be carefully selected so that the design slope of 2.5H:1V can be constructed.

Material Type: Certain granular materials are resistant to developing excess pore pressures and quickly dissipate pressures that do develop. The native sands at the site appear to be in this category. Other sands, due to their particle angularity and/or grain size distribution are prone to development of excess intergranular pore pressures and are slow to dissipate pore pressures. For this reason, the appropriate selection of capping material would greatly facilitate construction. In general, such a material will have a relatively low fines content.

<u>Placement Technique</u>: Excess pore pressures are related to the weight of overlying material, and the rate of dissipation of these pressures is related to the length of the drainage path. Thus, the rate of placement must be controlled in order to control pore pressure buildup and provide a short drainage path. The EPA guidance document clearly states,

> "Stability immediately after placement is most critical, before any excess pore water pressure due to the weight of the cap layer has dissipated. Gradual placement of capping materials over a large area will reduce the potential for such localized failures in most cases. For example, the sand cap placed in Hamilton Harbor, Ontario was placed in three separate passes (Zeman and Patterson 1996a). Settlement of the cap occurs as the sediments consolidate simultaneously with the dissipation of excess pore water pressure while gaining additional strength" (U.S. EPA, 1998).

The McCormick & Baxter project differs in that the existing sediments will quickly dissipate pore pressures. So, here we are more concerned with controlling pore pressures within the cap itself rather than within the bottom sediments.

Palermo documents a method of slow placement of granular materials using a split-hull barge:

> "A layer of capping material can be spread or gradually built up using bottom-dump barges if provisions are made for controlled opening and/or movement of the barges. This can be accomplished by slowly opening a conventional split-hull barge over a time frame of 30 to 60 minutes, depending on the size of the barge. Such techniques have been successfully used for controlled placement of predominantly coarse-grained sandy capping materials (Sumeri 1989). The gradual opening of the split-hull allows the material to be released from the barge in a sprinkling manner. If tugs are used to slowly move the barge during the release, the material can be spread in a thin layer over a large area. Multiple barge loads would be necessary to cap larger areas in an overlapping manner." (Palermo, 1992).

It has been suggested that control of stability during construction might be accomplished using a stone berm (Corps, 2000a) or sheet piles (Corps, 2000b). In our opinion, careful material selection and control of construction practices, written into the project specifications, is a preferable method of ensuring slope stability during construction. The proper selection of a high-strength granular capping material will serve the dual purpose of also ensuring long-term slope stability as discussed in the previous section. We recommend that placement of the sand cap on steep slopes occur in several layers. The number of passes will be dependent on the cap material selected and the method of placement.

Seismic Considerations

Liquefaction occurs when loose, saturated and relatively cohesionless soil deposits temporarily lose strength as a result of earthquake shaking. Primary factors controlling the development of liquefaction include intensity and duration of strong ground motion, characteristics of subsurface soil, in-situ stress conditions and the depth to groundwater. We estimated soil liquefaction potential of sands using SPT N-values measured in each boring, and the methodology of Robertson and Fear (1997). In addition, we assumed a 500-year return period earthquake for the liquefaction analyses, which corresponds to a peak horizontal ground acceleration of 0.20g (Geomatrix, 1995). Results of our analyses indicate the majority of the native sands within the upper 25 feet are borderline liquefiable during such an event.

Potential effects of soil liquefaction include lateral spreading and liquefaction-induced settlement. Lateral spreads involve down-slope movement of large volumes of liquefied soil. Based on our analyses and the limited laboratory test results, the potential for significant liquefaction-induced lateral spreading or settlement is considered moderate. We have not performed analyses to predict the magnitude of lateral spreading or settlement. We recommend additional studies be performed to further evaluate the likelihood of earthquake-induced slope movement. Such studies would not require additional exploration but may include analysis of site specific seismic response and analysis of slope deformation, as well as additional laboratory testing on existing sediment samples and proposed cap materials.

LIMITATIONS

We have prepared this report for Ecology and Environment, Inc. for use in preliminary design of a portion of this project. Because the report is preliminary, it should not be provided to contractors for bidding and estimating purposes. The conclusions and interpretations presented in this report should not be construed as a warranty of the subsurface conditions. Experience has shown that soil and ground water conditions can vary significantly over small distances. Inconsistent conditions can occur between explorations and may not be detected by a geotechnical study. If, during future site operations or explorations, subsurface conditions are encountered which vary appreciably from those described herein, HWA should be notified for review of the recommendations of this report, and revision of such if necessary.

Within the limitations of scope, schedule and budget, HWA attempted to execute these services in accordance with generally accepted professional principles and practices in the field of geotechnical engineering in the area at the time the report was prepared. No warranty, expressed or implied, is made. The scope of our work did not include environmental assessments or evaluations regarding the presence or absence of hazardous substances in the soil, surface water, or ground water at this site.

We appreciate this opportunity to be of service.

Sincerely,

HWA GEOSCIENCES INC.

André D. Maré, P.E.
Senior Geotechnical Engineer

ADM:TK:adm

Attachments:

References	
Figure 1.	Site and Exploration Plan
Figure 2.	Slope Profile A-A'
Appendix A.	Field Investigation
Appendix B.	Laboratory Testing
Appendix C.	Explorations by Others

REFERENCES

Geomatrix, Inc., 1995, *Seismic Design Mapping for the State of Oregon*, Oregon Department of Transportation, January, 1995.

Palermo, M.R., Clausner, J.E., Rollings, M.P., Williams, G.L., and Myers, T.E., 1998, *Guidance for Subaqueous Dredged Material Capping*, Dredging Operations and Environmental Research Program, Technical Report DOER-1, U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, Mississippi, June, 1998.

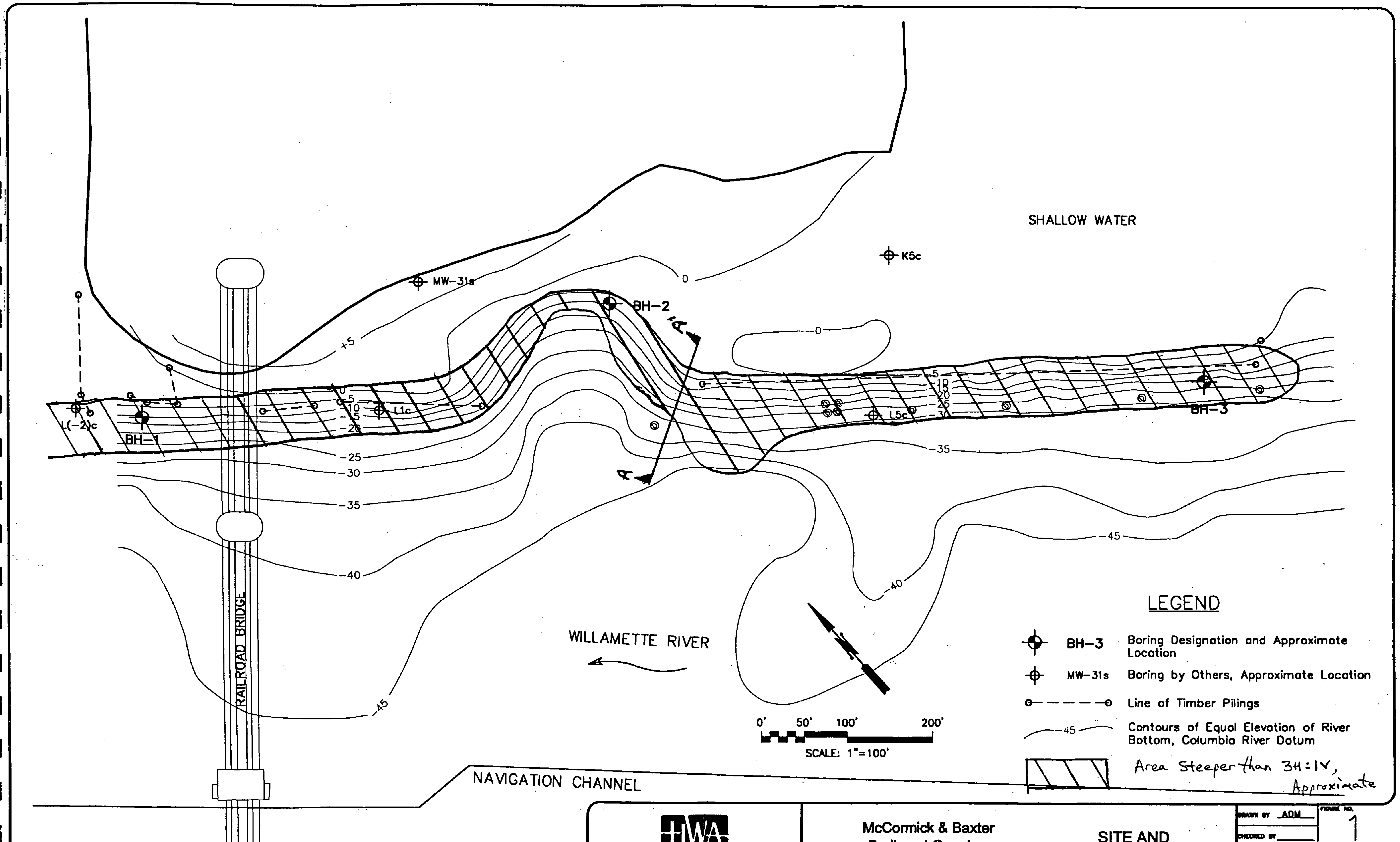
Palermo, M.R., 1992, *Equipment and Placement Techniques for Capping*, Dredging Research Technical Notes, DRP-5-05, U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, Mississippi, June, 1992.

Robertson, P.K, and Fear, C.E., 1997, *Cyclic Liquefaction and its Evaluation based on SPT and CPT*, National Center For Earthquake Engineering Research (NCEER) Workshop.

United States Environmental Protection Agency (U.S. EPA), 1998, *Assessment and Remediation of Contaminated Sediments (ARCS) Program, Guidance for In-Situ Subaqueous Capping of Contaminated Sediments*, U.S. EPA Great Lakes Program Office, Chicago, Illinois, November 30, 1998.

U.S. Army Corps of Engineers, Seattle District, 2000a, "Data Needs Report", letter from M. Ramsey, Project Manager to Oregon Department of Environmental Quality, August 29, 2000.

U.S. Army Corps of Engineers, Seattle District, 2000b, status letter from M. Ramsey, Project Manager to Oregon Department of Environmental Quality, July 27, 2000.



HWA GEOSCIENCES INC.

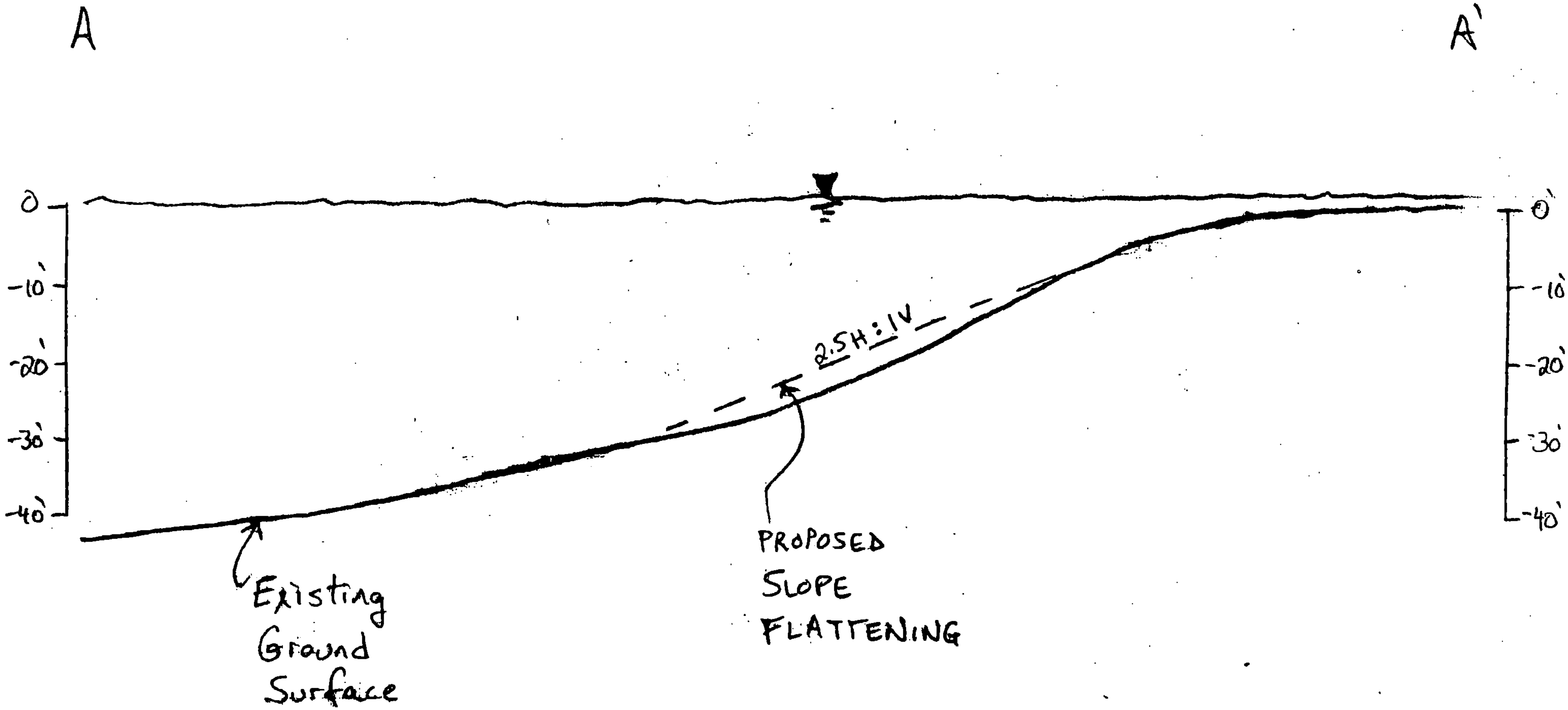
McCormick & Baxter
Sediment Capping
Portland, Oregon

SITE AND
EXPLORATION PLAN

DRAWN BY ADM	FIGURE NO. 1
CHECKED BY	
DATE 11.30.00	PROJECT NO. 2000-115

C:\1JOBS\2000\2000115002.DWG

Note: This page is intentionally left blank.



SCALE
1" = 20'

PROFILE
A-A'

FIGURE 2

APPENDIX A

FIELD INVESTIGATION

RELATIVE DENSITY OR CONSISTENCY VERSUS SPT N-VALUE

COHESIONLESS SOILS			COHESIVE SOILS		
Density	N (blows/ft)	Approximate Relative Density(%)	Consistency	N (blows/ft)	Approximate Undrained Shear Strength (psf)
Very Loose	0 to 4	0 - 15	Very Soft	0 to 2	<250
Loose	4 to 10	15 - 35	Soft	2 to 4	250 - 500
Medium Dense	10 to 30	35 - 65	Medium Stiff	4 to 8	500 - 1000
Dense	30 to 50	65 - 85	Stiff	8 to 15	1000 - 2000
Very Dense	over 50	85 - 100	Very Stiff	15 to 30	2000 - 4000
			Hard	over 30	>4000

USCS SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP DESCRIPTIONS	
Coarse Grained Soils	Gravel and Gravelly Soils	Clean Gravel (little or no fines)	GW	Well-graded GRAVEL
			GP	Poorly-graded GRAVEL
	More than 50% of Coarse Fraction Retained on No. 4 Sieve	Gravel with Fines (appreciable amount of fines)	GM	Silty GRAVEL
			GC	Clayey GRAVEL
More than 50% Retained on No. 200 Sieve Size	Sand and Sandy Soils	Clean Sand (little or no fines)	SW	Well-graded SAND
			SP	Poorly-graded SAND
	50% or More of Coarse Fraction Passing No. 4 Sieve	Sand with Fines (appreciable amount of fines)	SM	Silty SAND
			SC	Clayey SAND
Fine Grained Soils	Silt and Clay	Liquid Limit Less than 50%	ML	SILT
			CL	Lean CLAY
			OL	Organic SILT/Organic CLAY
50% or More Passing No. 200 Sieve Size	Silt and Clay	Liquid Limit 50% or More	MH	Elastic SILT
			CH	Fat CLAY
			OH	Organic SILT/Organic CLAY
Highly Organic Soils			PT	PEAT

TEST SYMBOLS

- %F Percent Fines
- AL Atterberg Limits: PL = Plastic Limit, LL = Liquid Limit
- CBR California Bearing Ratio
- CN Consolidation
- DD Dry Density (pcf)
- DS Direct Shear
- GS Grain Size Distribution
- K Permeability
- MD Moisture/Density Relationship (Proctor)
- MR Resilient Modulus
- PID Photoionization Device Reading
- PP Pocket Penetrometer
  Approx. Compressive Strength (tsf)
- SG Specific Gravity
- TC Triaxial Compression
- TV Torvane
  Approx. Shear Strength (tsf)
- UC Unconfined Compression

SAMPLE TYPE SYMBOLS

- 2.0" OD Split Spoon (SPT) (140 lb. hammer with 30 in. drop)
- Shelby Tube
- 3.0" OD Split Spoon with Brass Rings
- Small Bag Sample
- Large Bag (Bulk) Sample
- Core Run
- Non-standard Penetration Test (with split spoon sampler)

GROUNDWATER SYMBOLS

- ∇ Groundwater Level (measured at time of drilling)
- ▼ Groundwater Level (measured in well or open hole after water level stabilized)

COMPONENT DEFINITIONS

COMPONENT	SIZE RANGE
Boulders	Larger than 12 in
Cobbles	3 in to 12 in
Gravel	3 in to No 4 (4.5mm)
Coarse gravel	3 in to 3/4 in
Fine gravel	3/4 in to No 4 (4.5mm)
Sand	No. 4 (4.5 mm) to No. 200 (0.074 mm)
Coarse sand	No. 4 (4.5 mm) to No. 10 (2.0 mm)
Medium sand	No. 10 (2.0 mm) to No. 40 (0.42 mm)
Fine sand	No. 40 (0.42 mm) to No. 200 (0.074 mm)
Silt and Clay	Smaller than No. 200 (0.074mm)

COMPONENT PROPORTIONS

PROPORTION RANGE	DESCRIPTIVE TERMS
< 5%	Clean
5 - 12%	Slightly (Clayey, Silty, Sandy)
12 - 30%	Clayey, Silty, Sandy, Gravelly
30 - 50%	Very (Clayey, Silty, Sandy, Gravelly)

Components are arranged in order of increasing quantities.

NOTES: Soil classifications presented on exploration logs are based on visual and laboratory observation.
Soil descriptions are presented in the following general order:

Density/consistency, color, modifier (if any) GROUP NAME, additions to group name (if any), moisture content. Proportion, gradation, and angularity of constituents, additional comments. (GEOLOGIC INTERPRETATION)

Please refer to the discussion in the report text as well as the exploration logs for a more complete description of subsurface conditions.

MOISTURE CONTENT

DRY	Absence of moisture, dusty, dry to the touch.
MOIST	Damp but no visible water.
WET	Visible free water, usually soil is below water table.

HWA GEOSCIENCES INC.

McCormick & Baxter Sediment Capping
Portland, Oregon

LEGEND OF TERMS AND SYMBOLS USED ON EXPLORATION LOGS

PROJECT NO.: 2000-115 FIGURE: A-1

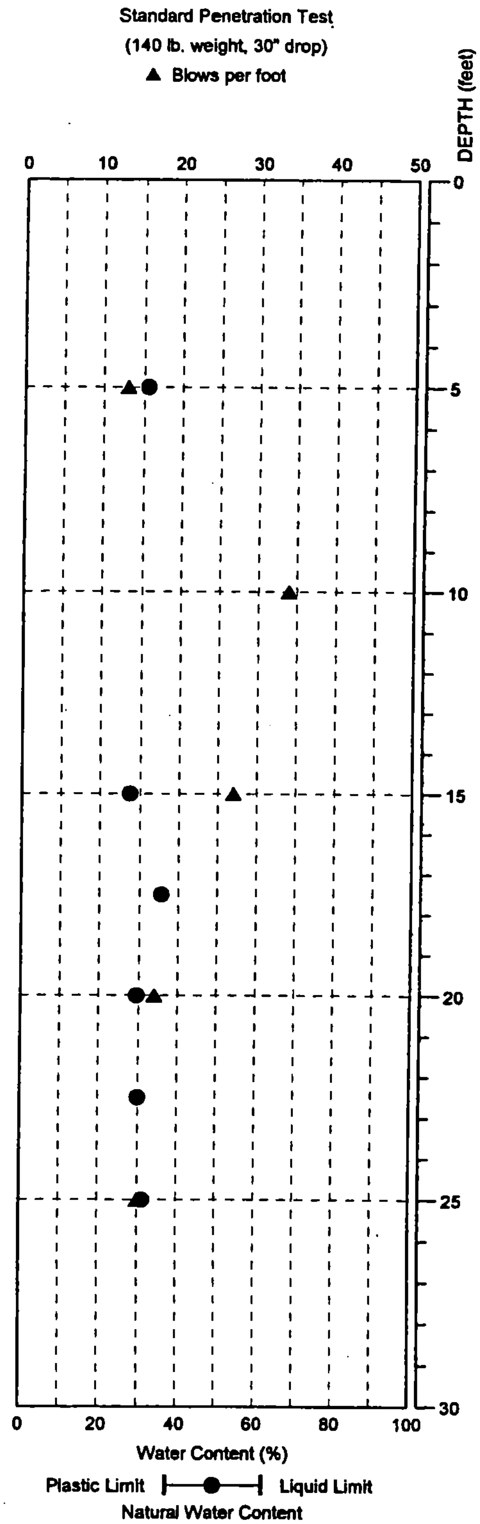
LEGEND 2000115.GPJ 12/6/00

DRILLING COMPANY: Subsurface Technologies Inc.
DRILLING METHOD: Mud rotary with 6" OD casing
SAMPLING METHOD: SPT w/ cathead
SURFACE ELEVATION: -11.50 ± feet

LOCATION: N 705,018.55; E 7,627,131.75
DATE STARTED: 11/03/2000
DATE COMPLETED: 11/03/2000
LOGGED BY: K. Knapp

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
0	SP SM	Loose, dark gray, poorly-graded SAND with silt, wet. Slight petroleum odor.			
			S-1	P	
5		Becomes medium dense	S-2	7-6-7	GS %F=9.7
	SP	Dense, dark gray, gravelly fine SAND, trace silt, wet. Slight petroleum odor.	S-3	24-27-25	GS
10		No Sample Recovery.	S-4	15-16-18	
	SP SM	Medium dense, dark gray, poorly-graded SAND with silt, trace fine gravel, wet.	S-5	P	
15			S-6	14-10-17	
			S-7	17-15-13	
20		@ 20 feet: decreasing gravel	S-8	6-8-9	
			S-9	14-27-24	GS %F=8.6
25			S-10	4-6-9	

Total Depth = 26.5 feet



DRAFT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

McCormick & Baxter Sediment Capping
Portland, Oregon

BORING:
BH-1

PAGE: 1 of 1

PROJECT NO.: 2000-115 FIGURE: A-2

BORING 2000115.GPJ 12/6/00

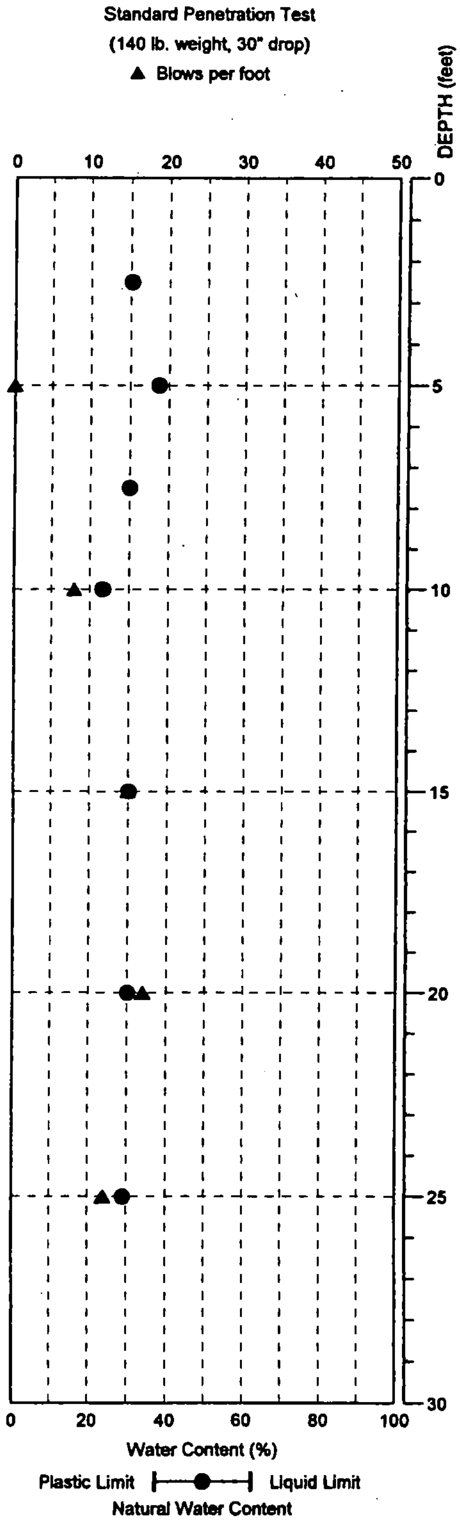
DRILLING COMPANY: Subsurface Technologies Inc.
DRILLING METHOD: Mud rotary with 6" OD casing
SAMPLING METHOD: SPT w/ cathead
SURFACE ELEVATION: -9.000 ± feet

LOCATION: N 704,753.81; E 7,627,627.31
DATE STARTED: 11/03/2000
DATE COMPLETED: 11/03/2000
LOGGED BY: K. Knapp

DEPTH (feet)	SYMBOL	USCS SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	GROUNDWATER
0		SP	Loose, dark gray, poorly-graded SAND. Trace silt and fine gravel, wet. Slight petroleum odor.					
					S-1	P	GS %F=4.7	
5		SP SM	Loose to very loose, dark gray, poorly graded SAND with silt, wet.		S-2	0	GS %F=7.7	
					S-3	5-5-7	GS	
10		SP	Loose, dark gray, poorly-graded SAND, trace fine gravel and silt, wet.		S-4	7-4-4	GS %F=2.8	
					S-5	P		
15			@15 feet: becomes medium dense		S-6	4-6-9		
		SP SM	Medium dense, dark gray, poorly graded SAND with silt, wet.		S-7	13-29-27		
20					S-8	7-7-10	GS %F=5.1	
					S-9	P		
25					S-10	5-5-8		

Total Depth = 26.5 feet

DRAFT



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

McCormick & Baxter Sediment Capping
Portland, Oregon

BORING: BH-2

PAGE: 1 of 1

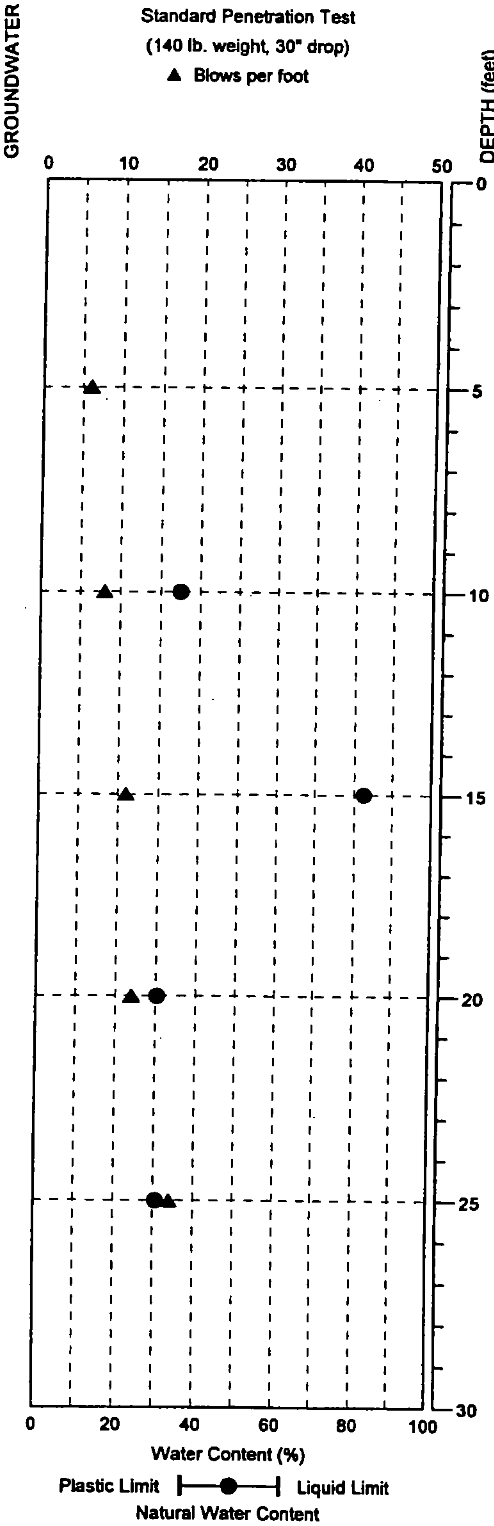
PROJECT NO.: 2000-115 FIGURE: A-3

DRILLING COMPANY: Subsurface Technologies Inc.
DRILLING METHOD: Mud rotary with 6" OD casing
SAMPLING METHOD: SPT w/ cathead
SURFACE ELEVATION: -22.50 ± feet

LOCATION: N 704,220.9; E 7,628,080.2
DATE STARTED: 11/02/2000
DATE COMPLETED: 11/02/2000
LOGGED BY: K. Knapp

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	GROUNDWATER
0	SP	Loose, dark gray poorly graded SAND, wet.				
			S-1	P	GS	
5	SP	Loose to medium dense, dark gray, poorly graded fine to medium grained SAND, trace silt and fine gravel, wet.	S-2	4-3-3		
			S-3	7-8-6	GS	
10			S-4	3-4-4	GS %F=3.6	
			S-5	P		
15		@14 to 16.5 feet: scattered organics (wood fragments)	S-6	4-5-6		
			S-7	8-8-13		
20			S-8	6-6-6	GS %F=3.9	
			S-9	P		
25		@25 feet: increasing silt	S-10	5-7-10		

Total Depth = 26.5 feet



DRAFT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

McCormick & Baxter Sediment Capping
Portland, Oregon

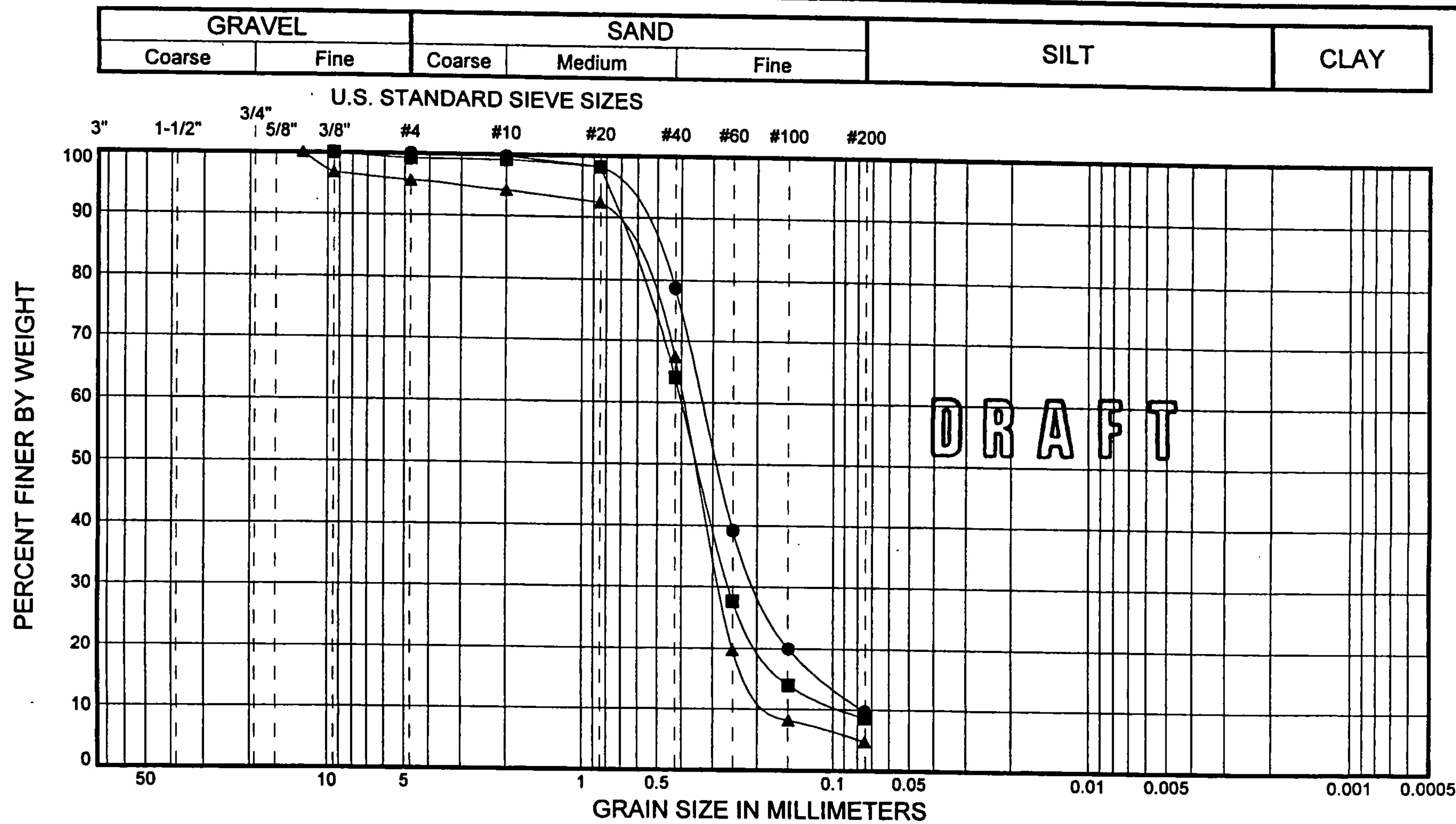
BORING:
BH-3

PAGE: 1 of 1

PROJECT NO.: 2000-115 FIGURE: A-4

APPENDIX B

LABORATORY TESTING



SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION	% MC	LL	PL	PI	% Gravel	% Sand	% Fines
●	BH-1	S-2	5.0 - 6.5	(SP-SM) Dark gray, poorly-graded SAND with silt	31					90.3	9.7
■	BH-1	S-9	22.5 - 24.0	(SP-SM) Dark gray, poorly-graded SAND with silt	30				0.8	90.6	8.6
▲	BH-2	S-1	2.5 - 4.5	(SP) Dark gray, poorly-graded SAND	30				4.5	90.8	4.7

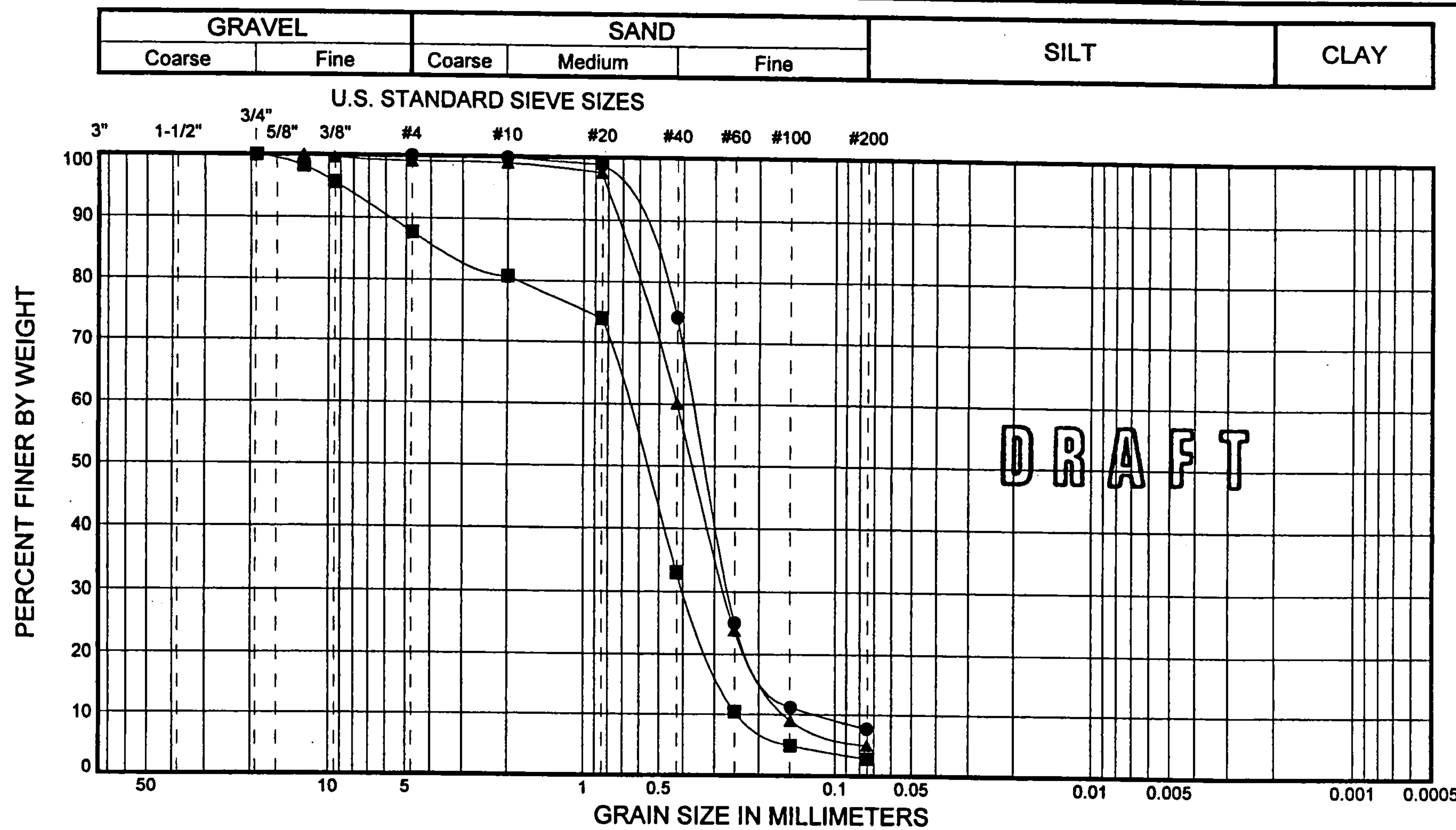
HWA GEOSCIENCES INC.

McCormick & Baxter Sediment Capping
Portland, Oregon

GRAIN SIZE
DISTRIBUTION
TEST RESULTS

HWAGRSZ 2000115.GPJ 12/8/00

PROJECT NO.: 2000-115 FIGURE: B-1



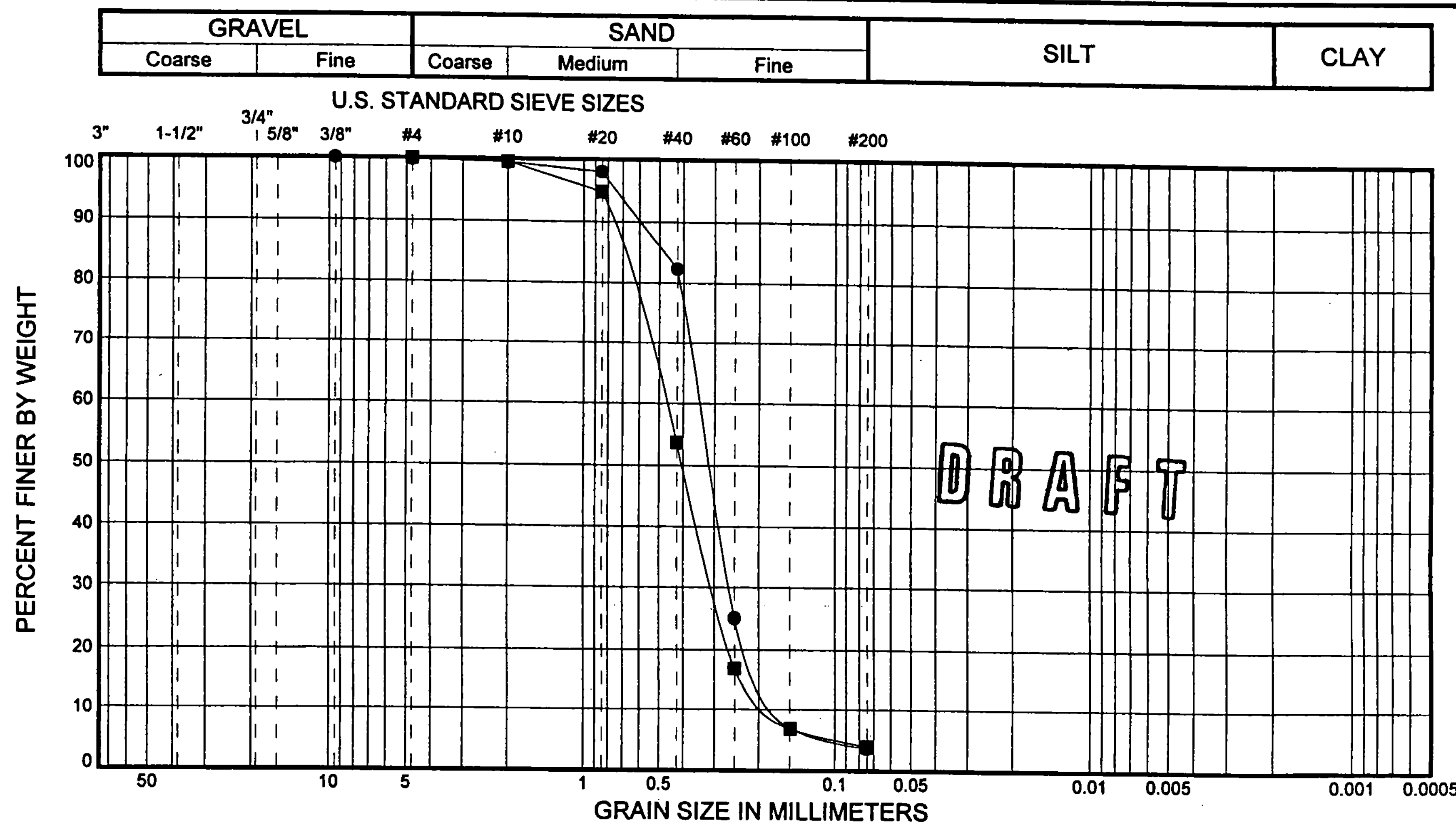
SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION	% MC	LL	PL	PI	% Gravel	% Sand	% Fines
●	BH-2	S-2	5.0 - 6.5	(SP-SM) Dark gray, poorly-graded SAND with silt	37					92.3	7.8
■	BH-2	S-4	10.0 - 11.5	(SP) Dark gray, poorly-graded SAND	23				12.3	84.8	2.9
▲	BH-2	S-8	20.0 - 21.5	(SP-SM) Dark gray, poorly-graded SAND with silt	30				0.9	94.0	5.1

HWA GEOSCIENCES INC.

McCormick & Baxter Sediment Capping
Portland, Oregon

GRAIN SIZE DISTRIBUTION TEST RESULTS

PROJECT NO.: 2000-115 FIGURE: B-2



SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION	% MC	LL	PL	PI	% Gravel	% Sand	% Fines
●	BH-3	S-4	10.0 - 11.5	(SP) Dark gray, poorly-graded SAND	35				0.2	96.2	3.6
■	BH-3	S-8	20.0 - 21.5	(SP) Dark gray, poorly-graded SAND	30					96.1	3.9

HWA GEOSCIENCES INC.

McCormick & Baxter Sediment Capping
Portland, Oregon

GRAIN SIZE DISTRIBUTION TEST RESULTS

PROJECT NO.: 2000-115

FIGURE: B-3

APPENDIX C

EXPLORATIONS BY OTHERS

	OVM (ppm)	SHEEN/CAT.	%RECOVERY	SAMPLES	LITHOLOGIC DESCRIPTION	EXPLANATION
						FIELD SCREENING
	7					OVM - Organic vapor monitor values measured in ppm.
						SHEEN CATEGORY (shown on borehole logs).
		NS				NS - No Sheen.
		SS				SS - Slight Sheen.
		MS				MS - Moderate Sheen.
		HS				HS - Heavy Sheen.
						SAMPLING
						ENVIRONMENTAL SAMPLE - Sample submitted for analysis or archived for possible future analysis (shown on monitoring wells and BH-27, BH-28, and BH-29 logs).
			100			% RECOVERY - Length of sample recovered/sampler penetration.
						SAMPLER - Type of device.
						3-inch O.D. California split spoon, 1.5 feet long.
						3-inch O.D California split spoon, 2.5 or 5.0 feet long.
						2-inch O.D. split spoon, 1.5 feet long.
						3-inch O.D Shelby tube, 2.0 feet long.
						Grab sample from auger flights.
						OTHER
						NA - Information not available.
						Water level on date as noted.

PTI
ENVIRONMENTAL SERVICES

WELL MW-31s

PROJECT MCCORMICK & BAXTER CREOSOTING
LOCATION PORTLAND, OREGON
CONTRACT NUMBER DEQ C8421603
GEOLOGIST/ENGINEER D. LIVERMORE
DRILLING CONTRACTOR GEOTECH EXPL.
DRILLING METHOD MOD. HOLLOW STEM AUGER

DEPTH OF BORING 30.0 FEET
DATE (s) DRILLED JULY 29, 1991
COORDINATES 704912.440, 1425558.050
WELL CASING ELEVATION 17.10 FEET
SURFACE PAD ELEVATION 12.47 FEET
TOTAL WELL CASING LENGTH 24.30 FEET

OVM (ppm)	% RECOVERY	SAMPLER
0.0	100	2
0.0	53	8
0.0	67	10
1.0	73	6
1.0	53	4
11.0	67	6
0.0	73	2
2.0	67	5
1.0	67	6
1.0	67	5
1.0	100	5
1.0	100	3
1.0	73	3
1.0	100	7
0.0	100	7
1.0	100	8
0.0	67	8
0.0	53	11
0.0	53	28
0.0	20	23

DEPTH IN FEET: 0, 10, 20, 30

LITHOLOGIC DESCRIPTION: SP-SM

BORING DESCRIPTION

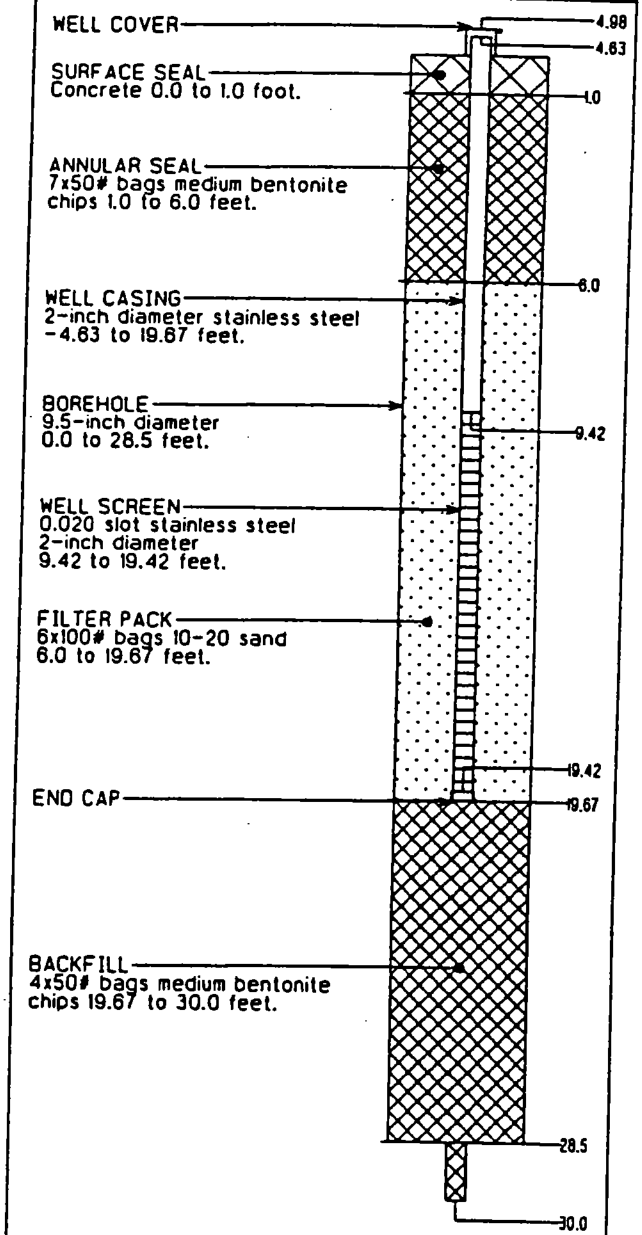
Fine to medium SAND with silt and trace gravel, occasional thin sandy silt interbeds, very dark brown to very dark gray, moist to wet.

Water level of 11.09 on 9/24/91

Total depth 30.0 feet.

Creosote-like odor observed in soil samples from 6.0 to 28.0 feet.

WELL CONSTRUCTION DETAILS



Depth	Material	Blow Counts
MW-28s (cont.)		
10.5–12.0	SP	1-1-3
12.0–13.5	SP-ML	1-2-1
13.5–15.0	ML	1-0-2
15.0–16.5	ML	1-1-1
16.5–18.0	ML	1-1-3
18.0–19.5	ML	1-1-3
MW-30s		
0–1.5	SP	3-3-5
1.5–3.0	SP	1-3-5
4.5–6.0	SP	2-3-5
6.0–7.5	SP	2-3-5
9.0–10.5	SP	3-4-5
10.5–12.0	SP	7-6-6
12.0–13.5	SP	5-6-6
13.5–15.0	SP	1-2-11
15.0–16.5	SP	2-4-6
16.5–18.0	SP	1-2-4
18.0–19.5	SP	3-3-4
19.5–21.0	SP-ML	2-2-4
21.0–22.5	SP	1-3-6
22.5–24.0	SP	2-5-7
24.0–25.5	SP	3-5-9
25.5–27.0	SP	1-2-4
27.0–28.5	SP	3-3-3
28.5–30.0	SP	2-3-6
MW-31s		
0–1.5	SP	1-1-1
1.5–3.0	SP	4-5-3
3.0–4.5	sp	1-3-7
4.5–6.0	SP	1-3-3
6.0–7.5	SP	1-1-3
7.5–9.0	SP	1-2-4
9.0–10.5	SP	0-1-1

Depth	Material	Blow Counts
MW-31s (cont.)		
10.5–12.0	SP	1-2-3
12.0–13.5	SP	1-3-3
13.5–15.0	SP	2-2-3
15.0–16.5	SP	1-2-3
16.5–18.0	SP	2-2-1
18.0–19.5	SP	2-2-1
19.5–21.0	SP	1-3-4
21.0–22.5	SP	0-3-4
22.5–24.0	SP	3-3-5
24.0–25.5	SP	2-4-4
25.5–27.0	SP	2-4-7
27.0–28.5	SP	5-15-13
28.5–30.0	SP	4-11-12

Note: Boreholes F4a, F4b, H5a, and H5b were grab sampled only.

Blow count data not usable for MW-25, BH-27, and BH-29.

Hammer weight and drop as per ASTM Method D1586-84, 140 lb and 30 in.

PTI
ENVIRONMENTAL SERVICES

BOREHOLE K5c

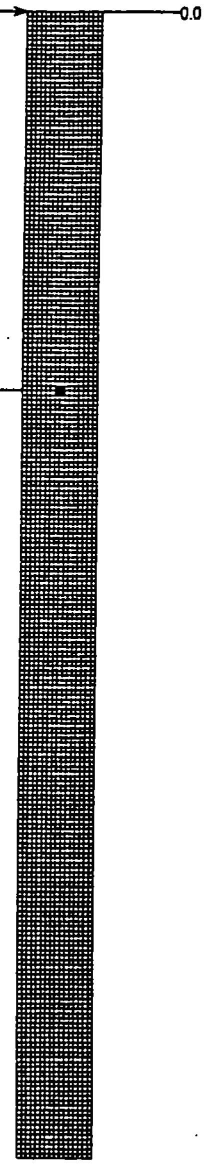
PROJECT MCCORMICK & BAXTER CREOSOTING
LOCATION PORTLAND, OREGON
CONTRACT NUMBER DEQ C8421635
GEOLOGIST/ENGINEER LIVERMORE, SAWYER
DRILLING CONTRACTOR PACIFIC TESTING LAB.
DRILLING METHOD HOLLOW STEM AUGER

DEPTH OF BORING 71.5 FEET
DATE (s) DRILLED 1/15/92
COORDINATES 704565.81, 1425989.16
APPROXIMATE
MUD LINE ELEVATION 1.3 FEET

DEPTH IN FEET	OVM (ppm)	SHEEN/CAT.	% RECOVERY	LITHOLOGIC DESCRIPTION	BORING DESCRIPTION
0	10	HS	53	ML	SILT, with small wood fragments, nonplastic, very dark gray, wet, strong creosote-like odor.
	9	HS	80		occasional sand stringers, heavy sheen, strong creosote-like odor
5	76	HS	93		trace sand and abundant wood fragments, strong creosote-like odor
	30	SS	100	SP	Fine SAND with trace silt and occasional wood fragments, very dark gray, wet, creosote-like sheen and odor.
10	16	HS	100		heavy sheen in blebs
	72	HS	100		strong creosote-like odor
15	60	HS	53		fine to medium sand
	6	SS	67		trace gravel, creosote-like odor
20	8	SS	60		
	14	SS	40		creosote-like odor
25	15	SS	7		
	10	SS	87		no gravel, slight creosote-like odor
30					

CONSTRUCTION DETAILS

BOREHOLE
10-inch O.D. (4-inch I.D.)
0.0 to 70.0 feet, 3-inch
O.D. 70.0 to 71.5 feet.



BACKFILL
14x50# bags bentonite slurry
0.0 to 71.5 feet.

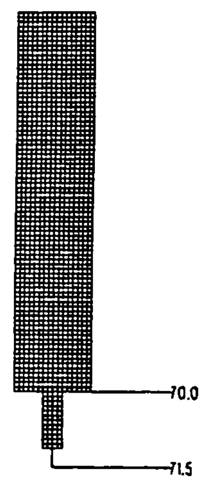
BOREHOLE K5c

DEPTH IN FEET	OVM (ppm)	SHEEN/CAT.	% RECOVERY	SAMPLER	LITHOLOGIC DESCRIPTION	BORING DESCRIPTION	CONSTRUCTION DETAILS
30	6	SS	73		SP	Fine SAND with trace silt and occasional wood fragments, very dark gray, wet, creosote-like odor	
						coarsening, sheen in blebs	
	18	SS	40				
35	5	HS	67			heavy sheen in blebs	
	24	HS	80				
40	8	HS	67			heavy sheen in blebs	
	3	SS	100				
45	4	SS	80			increasing silt	
	7	SS	60				
50	2	SS	80				
	27	SS	80				
55	5	SS	87				
	5	SS	60				
60							

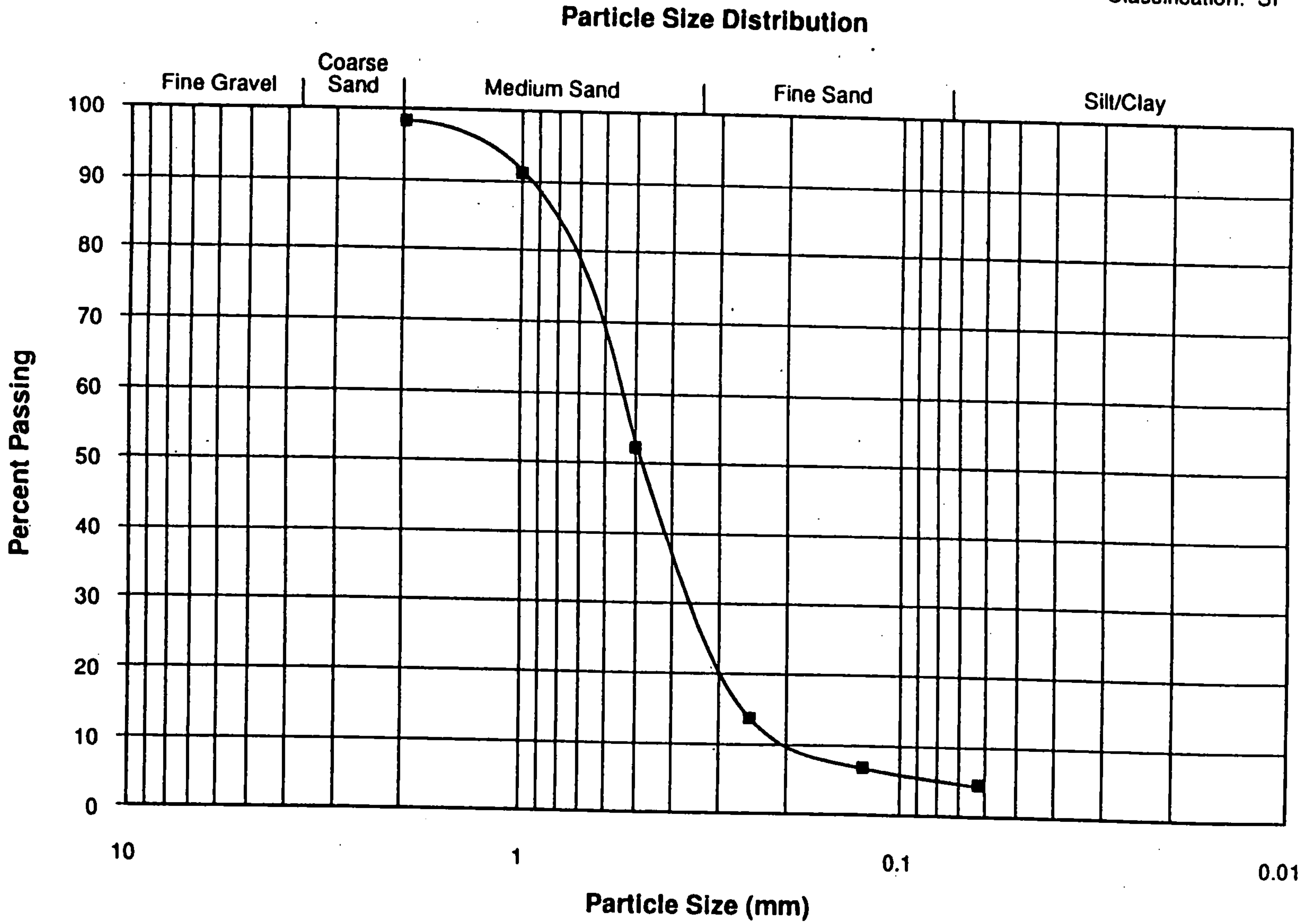
BOREHOLE K5c

DEPTH IN FEET	OVM (ppm)	SHEEN/CAT.	% RECOVERY	SAMPLER	LITHOLOGIC DESCRIPTION	BORING DESCRIPTION
60	3	SS	40		SP	Fine SAND with trace silt and occasional wood fragments, very dark gray, wet, creosote-like odor
	1	SS	27			
65						
	2	SS	100			large native wood fragments
	2	SS	NA			
70	2	SS	73			sheen occurs in very occasional blebs
						Total depth 71.5 feet.
75						
80						
85						
90						

CONSTRUCTION DETAILS



Station: K5c
Sample No: 35048
Depth: 10 ft
Classification: SP



E-142

C842-16-08 0992

BOREHOLE L (-2) C

PROJECT MCCORMICK & BAXTER CREOSOTING
LOCATION PORTLAND, OREGON
CONTRACT NUMBER DEQ C8421635
GEOLOGIST/ENGINEER VARNUM
DRILLING CONTRACTOR PACIFIC TESTING LAB.
DRILLING METHOD HOLLOW STEM AUGER

DEPTH OF BORING 51.3 FEET
DATE (s) DRILLED 1/24/92 to 1/27/92
COORDINATES 705058.62, 1425177.34
APPROXIMATE
MUD LINE ELEVATION -11.7 FEET

OVM (ppm)	SHEEN/CAT.	% RECOVERY
4.6	HS	11
0	SS	NA
0	SS	100
0	SS	67
0	SS	NA
0	SS	81
0	SS	56
0	SS	50
0	SS	50
0	SS	NA
0	SS	100
0	SS	33

DEPTH IN FEET: 0, 5, 10, 15, 20, 25, 30

LITHOLOGIC DESCRIPTION: PT; SP-SM; SP

BORING DESCRIPTION

WOOD debris with heavy sheen on water, no visible contamination in wood.

Fine to medium SAND with silt, trace fine gravel, 15 % wood debris, dark gray, wet, occasional iridescent sheen on water, less than 10% visible contamination.

decreasing wood

increasing sheen blebs in water

Fine to medium SAND with trace coarse sand and silt, dark gray, 2 or 3 sheen blebs, dilatancy rapid.

trace wood debris, very small sheen blebs

40 sheen blebs

3 sheen blebs

2 small sheen blebs (< 2mm)

occasional wood fragments, small sheen blebs

CONSTRUCTION DETAILS

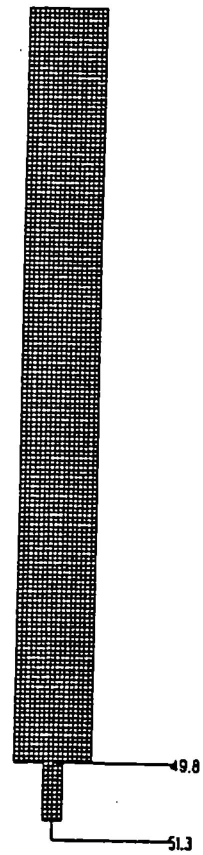
BOREHOLE
10-inch O.D. (4-inch I.D.)
0.0 to 49.8 feet, 3-inch
O.D. 49.8 to 51.3 feet.

0.0

BACKFILL
9x50# bags bentonite slurry
0.0 to 51.3 feet.

DEPTH IN FEET	OVM (ppm)	SHEEN/CAT.	% RECOVERY	SAMPLER	LITHOLOGIC DESCRIPTION	BORING DESCRIPTION
30	0	SS	NA		SP	Fine to medium SAND with trace coarse sand and silt, dark gray
	0	NS	56			
35	0	NS	83			
	0	NS	72			
40	0	NS	72			
45	0	NS	72			
50	0	NS	NA			Total depth 51.3 feet.
55						
60						

CONSTRUCTION DETAILS



PTI
ENVIRONMENTAL SERVICES

BOREHOLE L1c

PROJECT MCCORMICK & BAXTER CREOSOTING
LOCATION PORTLAND, OREGON
CONTRACT NUMBER DEQ C8421635
GEOLOGIST/ENGINEER VARNUM AND LOW
DRILLING CONTRACTOR PACIFIC TESTING LAB.
DRILLING METHOD HOLLOW STEM AUGER

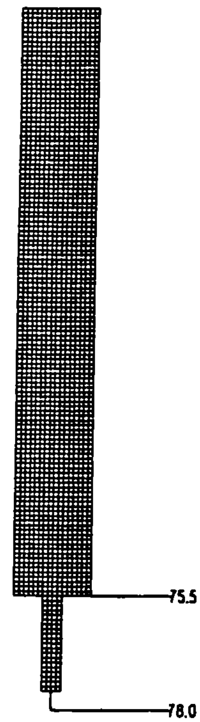
DEPTH OF BORING 78.0 FEET
DATE (s) DRILLED 1/21/92
COORDINATES 704830.75, 1425423.19
APPROXIMATE
MUD LINE ELEVATION -13.6 FEET

DEPTH IN FEET	OVM (ppm)	SHEEN/CAT.	% RECOVERY	SAMPLER	LITHOLOGIC DESCRIPTION	BORING DESCRIPTION	CONSTRUCTION DETAILS
0	45	HS	1		SP-SM	Fine to medium SAND with silt and wood fragments, dark gray, wet.	BOREHOLE 10-inch O.D. (4-inch I.D.) 0.0 to 75.5 feet, 3-inch O.D. 75.5 to 78.0 feet. 0.0
	52	HS	100		ML	SILT with 10 % wood and organic debris, dark gray, wet, 20% visible contamination.	
5	120	HS	100			increasing sand and decreasing wood, 20-30% visible contamination.	
	150	HS	33			20-30% visible contamination	
10	76	HS	67		SM	Fine to medium silty SAND with wood fragments, dark gray, wet.	BACKFILL 15x50# bags bentonite slurry 0.0 to 78.0 feet.
	55	HS	67				
15							
20					SP	Fine to medium SAND with trace silt, very dark gray, wet, 10% visible contamination.	
	38	SS	87				
25	57	SS	87			wood fragments	
	28	SS	100			sheen observed in three blebs, 5% visible contamination	
30	30	SS	87				

DEPTH IN FEET	OVM (ppm)	SHEEN/CAT.	% RECOVERY	SAMPLER	LITHOLOGIC DESCRIPTION	BORING DESCRIPTION	CONSTRUCTION DETAILS
30	30	SS	67		SP	Fine to medium SAND with trace silt, very dark gray, wet, 10% visible contamination	
	25	SS	67			decreasing wood, one bleb of contamination	
35	40	SS	67				
	10	SS	67			occasional blebs of sheen	
40	10	SS	80			occasional blebs of sheen, 5% visible contamination	
	13	SS	80				
45							
50	27.3	SS	80				
55	20	SS	80				
60							

DEPTH IN FEET	OVM (ppm)	SHEEN/CAT.	% RECOVERY	SAMPLER	LITHOLOGIC DESCRIPTION	BORING DESCRIPTION
60	16	SS	87		SP	Fine to medium SAND with trace silt, very dark gray, wet, less than 10 blebs of sheen, creosote-like odor
65	21	SS	67			
70	19	SS	100			five sheen blebs
75						
	1	NS	100			blow counts indicate very dense sand, no change in lithology
						Total depth 78.0 feet.
80						
85						
90						

CONSTRUCTION DETAILS



PTI
ENVIRONMENTAL SERVICES

BOREHOLE L5c

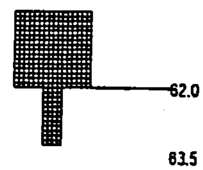
PROJECT MCCORMICK & BAXTER CREOSOTING
LOCATION PORTLAND, OREGON
CONTRACT NUMBER DEQ C8421635
GEOLOGIST/ENGINEER VARNUM
DRILLING CONTRACTOR PACIFIC TESTING LAB.
DRILLING METHOD HOLLOW STEM AUGER

DEPTH OF BORING 63.5 FEET
DATE (s) DRILLED 1/16/92 to 1/20/92
COORDINATES 704438.56, 1425849.84
APPROXIMATE
MUD LINE ELEVATION -30.7 FEET

DEPTH IN FEET	OVM (ppm)	SHEEN/CAT.	% RECOVERY	SAMPLER	LITHOLOGIC DESCRIPTION	BORING DESCRIPTION	CONSTRUCTION DETAILS
0		HS	80		ML	SILT, dark gray, moist, strong creosote-like odor.	BOREHOLE 0.0 10-inch O.D. (4.5-inch I.D.) 0.0 to 62.0 feet, 3-inch O.D. 62.0 to 63.5 feet.
		SS	67			trace sand and wood fragments	
5		SS	80		SW	Fine to coarse SAND with trace silt, dark gray, wet, strong creosote-like odor.	
	199	HS	NA		SP	Fine SAND with trace silt, dark gray, wet.	
10	499	HS	67			creosote-like odor	BACKFILL 17x50# bags bentonite slurry 0.0 to 63.5 feet.
	344	NS	67			fine to medium sand	
15		NS	80				
		NS	67			trace silt	
20		NS	53				
		NS	33				
25		NS	50				
		SS	50			faint creosote-like odor	
30							

DEPTH IN FEET	OVM (ppm)	SHEEN/CAT.	% RECOVERY	SAMPLER	LITHOLOGIC DESCRIPTION	BORING DESCRIPTION	CONSTRUCTION DETAILS
30		SS	33		SP	Fine SAND with trace silt, dark gray, wet	
		HS	47			high sheen in blebs, strong creosote-like odor	
35		HS	33			occasional sheen blebs	
		SS	33			slight sheen in blebs	
40		NS	33				
		SS	67			slight sheen in soil, 1 sheen bleb	
45		SS	67				
		NS	67				
50							
		SS	100			3 to 5 blebs of sheen	
55							
		NS	100				
60							

BOREHOLE L5c

DEPTH IN FEET	OVM (ppm)	SHEEN/CAT.	% RECOVERY	SAMPLER	LITHOLOGIC DESCRIPTION	BORING DESCRIPTION	CONSTRUCTION DETAILS
60					SP		
		NS	33			Total depth 63.5 feet.	
65							
70							
75							
80							
85							
90							

B

Preliminary Wave Studies and Parameters for Hydraulic Studies

OBA
Ogden Beeman & Associates, Inc.
Ports, Waterways and Marine Facilities
421 SW Sixth Avenue, Suite 1350
Portland, Oregon 97204-1612
(503) 223-8254 • Fax (503) 222-0657
obai@obai.com • www.obai.com

FAX TRANSMITTAL

TO: Susan Gardner, P.E.
Ecology and Environment, Inc.
Business (206)624-9537 Fax (206)621-9832

FROM: Jerald Ramsden, P.E.
Ogden Beeman & Associates, Inc.

DATE: December 8, 2000

PROJECT: McCormick & Baxter Sediment Remediation

SUBJECT: Sediment Cap 30% Design, Hydraulic Parameters

No. of pages sent (including cover sheet): 4

This fax outlines our preliminary hydraulic results. In this document I have included our results from the analysis of propeller-induced velocities, wind waves, and vessel wake.

Propeller-related water velocities
In order to estimate the water velocities affecting the cap due to propeller action, three vessels were considered in this analysis. Of the current vessel traffic, a large tractor tug operating along the underwater slope was judged to represent the highest propeller-induced velocities for this area. For the nearshore flats, the most propeller action was estimated to result from recreational vessels during periods of high water.

Guidelines on predicting water velocities due to propeller action have been developed by the U.S. Army Corps of Engineers (USACE) for the U.S. Environmental Protection Agency (EPA).

The estimated maximum bottom velocities anticipated due to propeller action over the cap are contained in Table 1. The bottom velocities were calculated for a range of water depths for each type of vessel.

TABLE 1. Maximum Bottom Velocities Estimated from Propeller Action

Water Depth (ft)	Propeller-Induced Bottom Water Velocities (fps)		
	Vessel 1: Tractor Tug (draft12.0 ft)	Vessel 2: 20' LOA Recreational (draft 2.9 ft)	Vessel 3: 57' LOA Recreational (draft 5.0 ft)
4-6 feet		6.2	
6-8 feet		3.7	5.4
11-13 feet		1.8	2.7
16-18 feet	5.4	1.2	1.8
22-24 feet	3.6		1.4
32-33 feet	2.2		
37-38 feet	1.8		

Directional wind analysis

Wind data from at least 38 years of record were used to estimate recurrence interval winds with a one percent chance of occurrence in a given year (i.e. this is sometimes referred to as a storm with an average recurrence interval of 100 years). The annual maximum wind data was modeled with a Type I Extreme Probability Distribution. The probability distribution was then used to estimate the wind speed corresponding to the 100-year storm. Due to the location of the project site and the orientation of over-water distances where appreciable wind-wave generation could occur: winds from directions corresponding to ESE, SE, S, SSW, W, WNW, and NW were analyzed.

Wind waves

Standard USACE guidance, as outlined in the Shore Protection Manual (1984), was used to calculate wind waves using the wind data obtained from the directional wind analysis. Deep-water wind wave heights from the SE were 3.1 ft with a wave period of 2.6 seconds. Deep-water wind-wave heights from WNW were 1.9 ft with a period of 2.1 seconds. These wave heights are valid in deep water before the wave "feels the bottom". The corresponding deepwater depths are approximately 17 ft and 11 ft for the SE and WNW wind waves, respectively. Several physical processes will modify the wave before it reaches the shoreline as discussed below.

Vessel wake

Based on published laboratory and field data by Sorensen (1973), we suggest a wave height of 3 ft with a wave period of 3 seconds be used to account for vessel wake at this project site. We suggest this wave be assumed to occur along the entire shoreline within the proposed cap area.

Wave transformation between deep water and the shoreline
Waves will likely undergo transformations due to several physical phenomena between deep water and the shoreline. Primary factors affecting wave transformation at this site include refraction, diffraction, shoaling, and wave breaking. A simplified approach to account for these effects was used to assess wave transformations at the project site, following procedures outlined in the Shore Protection Manual. Since the wind waves from the SE and the vessel wake were similar, with respect to wave height and wave period, we used a wave height of 3 ft and a wave period of 3 sec for the wave transformation process. As a result of the wave transformation analyses, we suggest a breaking wave height of 3.3 ft with a wave period of 3.0 seconds be assumed for the entire shoreline during preliminary cap design. This approach should be a conservative approximation according to the assumptions outlined above, except for wave focusing on headlands and at other shoreline locations due to wave propagation over underwater shoals. The only way to quantitatively assess the effect of headland or underwater shoal effects on wave transformations is through the use of somewhat laborious manual calculations or, more preferably, the use of a numerical model. Neither of these wave transformation analysis procedures have been conducted at this point in time. We suggest the project team proceed using the above suggested wave height as a preliminary approach. Based on our experience, we anticipate this will yield riprap rock sizes consistent with those historically used with success in the Willamette River (USACE post-flood correspondence, 1965). If after assessment by the project team and DEQ, it appears quantitative analysis of wave transformation for headlands and underwater shoals is warranted, we can conduct such an analysis.

The shoreline is subject to vessel wake at all water levels. According to USACE guidance in the Shore Protection Manual (1984), rock sized for stability against wave attack should be carried to a depth of 1.5 wave heights to two wave heights below the low water level. For this site we suggest the use of 0.0 ft Columbia River Datum (CRD) as the low water level for design of bankline stabilization features pertaining to wave action. Therefore, with a wave height of 3.3 ft, we suggest the bankline materials sized or designed for stability against waves be carried to a depth of -6 ft to -7 ft CRD.

Summary

We suggest the use of the propeller-induced bottom velocities and water depths included in Table 1. The SE wind wave heights at the shoreline, based on the 100-year windstorm (i.e. wind with a one-percent chance of occurrence in a given year), were nearly equal to those due to vessel wake. Therefore, we suggest use of a wave with a wave height of 3.3 ft and a wave period of three seconds for assessment of bankline stability.

Parsons
Brinckerhoff

421 SW Sixth Avenue
Suite 1350
Portland, OR 97204-1612
503-223-8254
Fax: 503-222-0657

February 13, 2001

Susan Gardner
Ecology and Environment, Inc.
1500 Wells Fargo Center
999 Third Avenue
Seattle, WA 98104

Dear Susan:

As requested, Parsons Brinckerhoff Quade & Douglas, Inc. has evaluated the hydraulic conditions of the Willamette River in the vicinity of the McCormick and Baxter Creosoting Company Site. The hydraulic conditions were evaluated to assist Ecology and Environment, Inc. (E&E) with the Basis of Design Report for the proposed sediment remediation cap.

A two-dimensional finite element computer model was used to typify the current patterns of the Willamette River in the vicinity of the proposed sediment cap. The computer model utilized was the U.S. Department of Transportation, Federal Highways Administration computer program FESWMS-2DH, Version 2c. The computer program is a Finite Element Surface-Water Modeling System for two-dimensional flow in the horizontal plane.

The finite element method is a numerical procedure for solving the differential equations encountered in problems of physics and engineering. FESWMS-2DH uses the Galerkin finite element method to solve the vertically integrated equations of momentum and continuity. The model solves for water depth and vertically averaged flow velocities. FESWMS-2DH is a modular set of computer programs developed to simulate surface-water flow. The programs that comprise the modeling system have been designed specifically to analyze flow at bridge crossings where complicated hydraulic conditions exist. The programs can also be used to model many other complex types of surface-water flow.

Application of the finite element method requires that the water body be divided into smaller regions called elements. An element can be either triangular or quadrilateral in shape and can be easily arranged to fit complex boundaries. For this project, elements were patterned to accurately reflect the existing and proposed bathymetric conditions at the site.

The bathymetric data utilized to create the finite element grid was taken from two sources. Large scale Willamette River data was obtained from U.S. Army Corps of Engineers channel and cross-line surveys conducted in 2000. Detailed bathymetric data at the site was obtained by the 1996, 1999, and 2000 project hydrographic surveys. The survey methods, dates, and areal extents were compared to combine the data and determine the final bathymetry for the two-dimensional model.

For this project approximately 4,300 elements and 12,000 node points were used to defined the computational grid. The model was developed to accurately reflect existing conditions along the Willamette River from river mile 6.0 to 8.4. The grid was then modified to reflect the proposed condition based on the sediment cap provided by E&E on January 24, 2001. The proposed cap has a thickness of three feet and a maximum slope of 2.5H:1V. The model that includes the cap also accounted for removal of the bulkhead and a re-graded slope at the bulkhead location near the center of the site.

Boundary conditions for the models consisted of the water surface elevation at the downstream end of the model and flow rate at the upstream end. The currently effective, Federal Emergency Management Agency (FEMA) flood insurance study was used as the basis for the boundary condition data on the Willamette River.

The two-dimensional model results for the 500-year flood (i.e. 0.2% annual chance of occurrence) velocities were calculated with the model and submitted to E&E previously. The boundary conditions used to model the 500-year flood include a downstream water surface elevation of 31.7 feet, NGVD and flow at the upstream face of 495,000 cfs. The model estimated that the maximum velocity, within the area to be capped, occurs near the railroad bridge pier with an approximate magnitude of seven feet per second. However, it should be noted that small scale, localized velocities may be larger than seven feet per second. The two-dimensional model used in this study does not resolve three-dimensional flows that occur at the bridge piers. Additional guidance concerning the bridge scour velocities will be provided with the hydraulics report.

The floodway condition was modeled by encroaching both riverbanks to the limits of the currently effective floodway boundary and running the model with the 100-year flood flow (i.e. 1.0% annual chance of occurrence). This model was run with existing bathymetry and with the proposed sediment cap bathymetry. These floodway condition models will be utilized to determine if the final sediment cap design causes a rise in base flood elevations within the floodway boundary. Results from this analysis will be included and discussed in the hydraulics report.

Sincerely,

Pete D. Di

Peter D. Dickerson, P.E.
Civil Engineer
Port and Marine Resource Center
Parsons Brinckerhoff Quade & Douglas, Inc.

C

Draft Section 01010

SECTION 01010
Summary of Work

1. GENERAL

1.1 SUMMARY

A. Items included in this section cover project site location, background information, the basic intent of the project, and administrative requirements.

1.2 DEFINITIONS

A. The terms "Owner" and "Agency" refer to the Oregon Department of Environmental Quality (DEQ).

B. The terms "Subcontractor" and "Contractor" refer to the firm contracted to perform the construction services described herein.

C. The terms "Agreement", "Supplement", "Contract", "Documents", or any combination of those words mean the Technical Contract Documents as described in paragraph 1.3, Technical Documents, below.

D. The term "Substantial Completion" refers to the point at which the project is sufficiently completed to be utilized for its intended purpose. The terms "Substantially Complete" and "Substantially Completed" as applied to any work refer to Substantial Completion thereof.

1.3 TECHNICAL DOCUMENTS

The Technical Documents that comprise the work scope are listed below:

A. Technical Specification Divisions 0 through 2.

B. Contract Drawings.

C. All addenda issued to the Technical Documents.

1.4 PREVIOUS STUDIES

A. Ecology & Environment, Inc. (E & E), 1983, Site Inspection, McCormick & Baxter Creosoting Company, EPA, Region 10.

B. CH2M Hill, 1985, McCormick & Baxter Creosoting Company Site Water and Soil Investigation, Interim Report, DEQ.

C. CH2M Hill, 1987, McCormick & Baxter Creosoting Company Portland Plant: Environmental contamination Site Assessment and Remedial Action Report, DEQ.

D. PTI Environmental Services, 1992, McCormick & Baxter Creosoting Company Remedial Investigation Report, DEQ.

E. PTI Environmental Services, 1992, McCormick & Baxter Feasibility Study Report, DEQ.

F. Ecology & Environment, Inc., 1993, Site Inspection, McCormick & Baxter Creosoting Company, EPA, Region 10.

G. PTI Environmental Services, 1995, Revised Feasibility Study, McCormick & Baxter Creosoting Company, DEQ.

H. Ecology & Environment, Inc., 1999, Sediment Remedial Design Sampling Data Summary Report, McCormick & Baxter Creosoting Company, DEQ.

I. HWA Geosciences, Inc., 2000, Preliminary Geotechnical Report, McCormick & Baxter Sediment Cap Project, for E & E.

J. Ogden Beeman and Associates, 2000, Sediment Cap 30% Design, Hydraulic Parameters, for E & E.

K. Ogden Beeman and Associates, 2000, Preliminary 2-D Hydraulic Model Results, FEMA 100-Year Flood Event, for E & E.

L. Ogden Beeman and Associates, 2001, Preliminary 2-D Hydraulic Model Results, FEMA 500-Year Flood Event, for E & E.

1.5 SITE LOCATION

A. The McCormick & Baxter site is located on the Willamette River in Portland, Oregon, downstream of Swan Island and upstream of the St. John's Bridge. The Willamette River flows to the northwest in the vicinity of the site.

B. Besides the river, the site is bordered by industrial properties along the river and by a residential area on the bluff along the northeastern border.

1.6 BACKGROUND INFORMATION

A. In the early 1900s, the first industrial structure, a sawmill, was built at the site. In 1944, the McCormick & Baxter Creosoting Company began wood-treating operations that continued until October 1991. From 1950 to 1965, waste oil containing creosote and/or PCP was applied to site soil for dust suppression in the central process area. Liquid process wastes reportedly were discharged to a low area near the tank farm before 1971. From 1968 to 1971, process wastes were disposed of in the former waste disposal area in the southwest portion of the site.
The site had a wastewater discharge outfall that discharged cooling water when the plant operated. Contact wastewater also was discharged from this outfall in the early years of operation.
Three major types of subsurface contamination are of concern at the site: contaminants dissolved in groundwater (aqueous phase), contaminants that are lighter than groundwater and tend to float (such as the medium aromatic treating oils), and contaminants that are denser than groundwater and tend to sink (such as creosote).

1.7 WORK INCLUDED

A. It is the intent of this project to place a sediment cap over the contaminated Willamette River sediments. As a part of this project, certain in-water structures will be demolished, as will selected shore-side structures.

B. The Contractor shall perform the following major items:

1. Demolish the bulkhead and regrade the landward fill to match the existing bank.

2. Demolish 11 monitoring wells in the vicinity of the bulkhead and onshore in the cap area.

3. Remove pilings, dolphins and submerged remnants of the creosote dock at the river bottom surface.

4. Regrade near-shore banks to 3H:1V slope or less.

5. Place 17-acre sediment cap consisting of sand, gravel, and revetment layers.

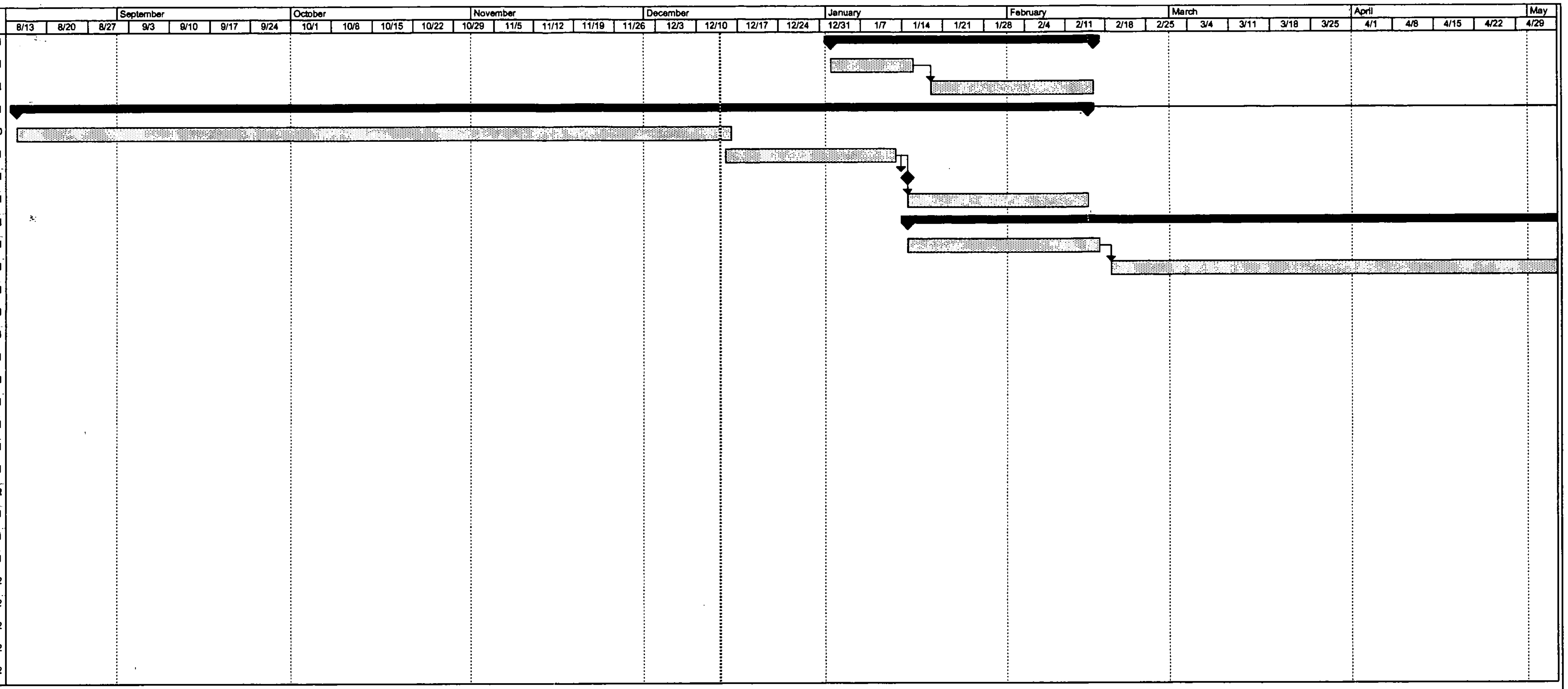
C. The Contractor shall minimize adverse impacts to the local environment during construction. The Contractor shall maintain work areas on and off site in a manner so as to protect local surface water quality and air quality, and control noise, dust, and erosion, in accordance with local, state, and federal regulations and Agency direction.

END OF SECTION

D

Construction Schedule

Task Name	Duration	Start	Finish
RD Sediment Data Collection	**6.6 wks**	**Tue 1/2/01**	**Thu 2/15/01**
Sediment SQAP data collection	2 wks	Tue 1/2/01	Mon 1/15/01
Prepare Final Sediment Data Summary Report	4 wks	Fri 1/19/01	Thu 2/15/01
RD Conceptual Design	**26.4 wks**	**Tue 8/15/00**	**Wed 2/14/01**
Prepare Draft Conceptual Design	17.8 wks	Tue 8/15/00	Fri 12/15/00
Project Team (DEQ, EPA, USACE) Review	4.2 wks	Fri 12/15/00	Fri 1/12/01
Comment/Discussion meeting	0 wks	Mon 1/15/01	Mon 1/15/01
Revise Conceptual Design Documents	4.6 wks	Mon 1/15/01	Wed 2/14/01
Permit Preparation	**31 wks**	**Mon 1/15/01**	**Fri 8/17/01**
Prepare Biological Evaluation/404(b)1	5 wks	Mon 1/15/01	Fri 2/16/01
BE/404(b)1 review period	26 wks	Mon 2/19/01	Fri 8/17/01
RD Final Design	**13.8 wks**	**Tue 5/15/01**	**Fri 8/17/01**
Prepare PreFinal Design Documents	7.8 wks	Tue 5/15/01	Fri 7/6/01
Project Team (DEQ, EPA, USACE) Review	2 wks	Mon 7/9/01	Fri 7/20/01
Prepare Final Design Documents	4 wks	Mon 7/23/01	Fri 8/17/01
RA Construction Contractor Procurement	**11 wks**	**Mon 8/20/01**	**Fri 11/2/01**
DAS Publication	1 wk	Mon 8/20/01	Fri 8/24/01
Bid Advertisement	4 wks	Mon 8/27/01	Fri 9/21/01
Bid Evaluation	2 wks	Mon 9/24/01	Fri 10/5/01
Contract Negotiation and Signing	4 wks	Mon 10/8/01	Fri 11/2/01
RA Implementation of Construction	**15 wks**	**Mon 11/5/01**	**Fri 2/15/02**
Submittal Review and Approval	2 wks	Mon 11/5/01	Fri 11/16/01
Field Mobilization	2 wks	Mon 11/5/01	Fri 11/16/01
Site Preparation	1 wk	Mon 11/19/01	Fri 11/23/01
Cap Emplacement	6 wks	Mon 12/3/01	Fri 1/11/02
Inspection/Acceptance of Work	1 wk	Mon 1/14/02	Fri 1/18/02
Field Demobilization	1 wk	Mon 1/21/02	Fri 1/25/02
As-Built Drawing Review/Approval	1 wk	Mon 1/28/02	Fri 2/1/02
Contract Close-Out	2 wks	Mon 2/4/02	Fri 2/15/02



Note: This page is intentionally left blank.

Task Name	Duration
RD Sediment Data Collection	**6.6 wks**
Sediment SQAP data collection	2 wks
Prepare Final Sediment Data Summary Report	4 wks
RD Conceptual Design	**28.4 wks**
Prepare Draft Conceptual Design	17.8 wks
Project Team (DEQ, EPA, USACE) Review	4.2 wks
Comment/Discussion meeting	0 wks
Revise Conceptual Design Documents	4.6 wks
Permit Preparation	**31 wks**
Prepare Biological Evaluation/404(b)1	5 wks
BE/404(b)1 review period	26 wks
RD Final Design	**13.8 wks**
Prepare PreFinal Design Documents	7.8 wks
Project Team (DEQ, EPA, USACE) Review	2 wks
Prepare Final Design Documents	4 wks
RA Construction Contractor Procurement	**11 wks**
DAS Publication	1 wk
Bid Advertisement	4 wks
Bid Evaluation	2 wks
Contract Negotiation and Signing	4 wks
RA Implementation of Construction	**16 wks**
Submittal Review and Approval	2 wks
Field Mobilization	2 wks
Site Preparation	1 wk
Cap Emplacement	6 wks
Inspection/Acceptance of Work	1 wk
Field Demobilization	1 wk
As-Built Drawing Review/Approval	1 wk
Contract Close-Out	2 wks